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Photo courtesy Crown Zellerbach Corp.

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Journal of Forestry

Official Organ of the Society of American Foresters

How to Make Progress in California Silviculture

Dietrich W. Muelder

SILVICULTURE is one of the central disciplines of the science forestry.[1] As such we find it represented at each of the world's forestry schools. For what part of the science forestry is silviculture responsible? In order for fruitful discussion we have to agree on what we mean when we say "Silviculture." The subdivision of a science is often less a question of subject matter than of the leading viewpoints with which subjects are dealt. Any silvicultural treatment applied to our forest stands also poses a problem for almost every other discipline of forestry. Therefore any attempt to divide forestry into the different disciplines according to subject matter is doomed to failure. To me all the nice schemes describing buildings where this or that discipline represents the foundation, other ones serve as pillars or walls, and another one as roof, seem worthless. There are no visible boundaries between the disciplines; they exist by logical subdivisions only.

Understanding the Scope

Silviculture as a discipline of forestry science deals with all known biological and technical aspects of all known methods of growing trees under forest conditions; and this for any human purpose, be it wood production, watershed management, or recreation. What these possibilities mean under these or those economic or managerial conditions is the concern of other disciplines. These disciplines thus deal with the same subject matter, but from different viewpoints. A planting method, for instance, considered to be too expensive at one place might be completely justified for urgent cases of erosion control. A cutting system, not the very best one from the viewpoint of timber production, may be chosen because of its usefulness for watershed management.

Progress in silviculture as a science depends upon realizing and filling with life by research and teaching the whole scope of facts and problems already recognized, and beyond that of all possibilities which might be of value in the future. In order to avoid being out-of-date when his advice is asked, the silviculturist has always to think and to work ahead of present day conditions. How else can he be prepared in time for new demands? Even under present demands ten different men will comment in ten different ways on what the conditions are and what they require or allow.

We would be much better off today and it would have been much more economical if, for instance, many more careful planting experiments by many more owners had been carried on year after year on a small scale; or if in many more places lighter cuts had been applied under different conditions, again on a small scale for comparisons. A tremendous job is ahead of us and we have to pay for sins of omission in the past.

An old mistake, which is obviously hard to overcome, is to say that silviculture as a science deals mainly with "silvicultural systems" or "cutting methods." How boringly can this matter be handled! Without doubt these systems and methods are and will always be important even though, perhaps because of misapplications in the early stages of forestry, this importance is often overlooked. But what significance do such systems have in restocking brush fields or for huge areas of second growth where for the next 30 to 50 years not much will happen that requires thinking in terms of silvicultural systems?

Here then is *answer one* to my topic: Overcome deficiencies which result from a narrow understanding of what silviculture deals with and for what it is responsible.

Responsibilities of the Silviculturist

There is another shortcoming: Silviculture is often understood as a science which sets certain norms to be followed in "good forestry." Some textbooks emanate such an attitude. Silviculture is not a moral institution and does not set norms. It deals both with solutions that might be called silviculturally "ideal" (i.e., ideal from the standpoint of perpetuating full productivity) and with all the problems that have arisen in the past and will certainly continue to arise in the future from certain human practices or catastrophes which inevit-

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[1] In the European tradition the term "science" is freely applied to both forestry and silviculture. The same usage is adopted here for purposes of convenience, not to raise the issue of whether "science" or "art" is the more appropriate term.

ably destroy productivity for a more or less long time.

Physicians study and give advice on how sportsmen can avoid breaking their bones; but, they are equally competent to set the broken bones. The physician's answer to certain diseases is not a moral lecture but a healing medicine.

Silviculture as a science deals with a continuing chain of questions like these: What is the very best solution if the primary objective is to restore or perpetuate full productivity? What is the second best treatment, or if even this one cannot be applied, what is the next best? And, if poor practice or a catastrophe has destroyed productivity completely, what has to be done then? Hydraulic engineers study what the very best dike is just as intensively as what might happen and what has to be done if the dike breaks.

Answer two: For progress, the silviculturist has to drop the attitude that silviculture is a kind of a moral institution entitled to distribute praise and bad marks. Instead, responsibility has to be taken for anything under the sun that might come up.

So much at this place for what silviculture as a science deals with.

Flexible Approach Required

Next, there is silviculture as an essential part of forestry practice. I believe that certain terms such as "practice of silviculture" have caused much confusion here and abroad. It seems to me we will get things straight much more easily when we realize that in fact there is only one real practice and that is forest management practice.

The manager has to consider many and often divergent viewpoints. Very important among these are those of silviculture, which are almost identical with those of maintaining, improving, or restoring productivity. Silviculture furnishes knowledge and advice of relative value only. From the viewpoint of silviculture, fill-in planting and cleaning here or a removal cut there may be desirable right now. However, it might not fit into the overall managerial task. Envisage a manager, a good and conscientious silviculturist himself, who realizes the urgent need for some release cuttings in a period of very poor market conditions. Under such circumstances it is often good forestry practice not to cut in spite of resultant silvicultural disadvantages.

At this point questions of priority, involving very difficult silvicultural and managerial problems, come up. It is easy to say this or that should be done. However, the question of what the consequences are if this or that is omitted completely, postponed, or done less intensively is often very hard to answer, and more than anything else serves to disclose the weakness of our silvicultural knowledge.

One might say that this difficulty applies only to the early stages of development of forest management. Later on everything necessary would be done at the ideal time and with the ideal intensity — ideal from the silviculturist's viewpoint. I urge you not to believe this argument. This never will happen and has not happened even in the framework of the most intensive forestry. Weather conditions, cone crops, the insect and disease situation, and many other physical and biological things keep changing all the time, as do market conditions and conditions of employment and with them the task of forest management in general and the relative priority of management measures.

Answer three: It is impossible to train and to educate foresters sufficiently for the everyday requirements of forest management if we do not realize that there is no place in the field for an independent silvicultural practice. Rather there is an urgent need for very flexible silvicultural approaches to managerial needs, and—of course—vice versa.

Application of Available Knowledge

This might be the place to point out that silviculturists are not the only ones who sometimes behave poorly. Imagine a manager who in times when the market is down takes the reasonable stand that no money is available for silvicultural treatments, but who is even less ready to spend money in times of a good market because of the wonderful opportunity for making a lot of money. Whenever somebody explains the close connection between lumber market and silvicultural investments, nod consent first and then ask very politely for comments on his silvicultural investments during periods of good market conditions. There is a strong belief that better market conditions automatically improve forestry. They can just as well lead, and have led, to even more destruction if one is not ready technically, politically, or even morally for such conditions.

What we call silviculture then is either a certain discipline of the science forestry or a complex of knowledge and viewpoints to be used in forest management practice. To see silviculture this way is not to weaken it. Rather, it is the only way both (1) to strengthen silviculture as a science and (2) to secure the coherence of all its parts, which is increasingly jeopardized by claims of new fields.

That there are never independent silvicultural conclusions, and that silviculture cannot be practiced for itself does not mean that the silviculturist should not express what certain practices mean for the perpetuation of productivity. Some practices, also called "forestry," have nothing to do with what forestry is according to the SAF definition: "The scientific management of forests for the continuous production of goods and services." By definition there is no forestry without silviculture. Rather than to state that more silviculture is needed in forestry we should say that certain practices are not forestry at all.

Progress in silviculture can mean two very different things: First, progress by better use of the available silvicultural knowledge in forest management practice. This requires well trained and experienced field foresters. Second, progress by

research in the discipline silviculture.

As far as the application of available silvicultural knowledge is concerned we are dealing to a considerable extent with the competence of economics, management, and policy. The silviculturist cannot contribute much more than to make it clear time and again what will happen if such knowledge is not applied or, more simply, if we are not ready to learn from experience. To a considerable extent, whether or not a forest manager is in the position to apply what he himself knows would maintain, improve, or restore productivity is not a question of more silvicultural research.

When the same forest owner or manager, who in other fields of his business is absolutely up-to-date, suddenly starts a big planting job, inexperienced himself and with a crew of untrained people, then lack of relevant silvicultural knowledge or research is not responsible for failure, but lack of common sense. A similar statement can be made for certain cutting and logging practices that often destroy productivity for decades. Does it really depend upon more research to convince people that in many cases lighter cuts are urgently indicated and that the manager should prefer to allocate more money for better—silviculturally better—logging practices than spend money for anything else? I may quote a well known American forester: "Apart from fire protection the importance of reducing logging damage to a minimum transcends all else."

Like anyone else, a scientist is pleased when he is told how much he is needed or how much progress depends upon his work. However, no silviculturist, ecologist, geneticist, or soils man in California can honestly say that current silvicultural progress depends first of all upon his research. He should do everything to avoid taking this stand since it blurs the responsibility and nourishes an attitude on the side of the managers or owners that it is not their turn. It *is* their turn.

Architects or engineers do not tell people: "Don't build a house or a ship or a highway right now for we will find ways to do it much better in twenty or fifty years." Each generation has to make the best of its own knowledge. The main trouble in silviculture is that financially each generation can get along without it much more profitably than with it.

Here, my *fourth answer:* The forest owners or managers have to face the fact that enough knowledge is available to improve conditions a great deal without calling for more research.

Focus on Urgent Needs

All this does not mean, however, that there is not a tremendous job ahead to find out more possibilities and to develop more dependable, better, easier, and perhaps cheaper treatments. At this point a glance at my friends working here and abroad in ecology, genetics, soils, and other fields closely related to silviculture is needed. We sometimes find a strong belief that there is an almost automatic connection between progress in those fields and in silviculture; the more research and knowledge in those fields the more progress could be made simultaneously in silviculture by just applying that knowledge.

I will comment on this opinion by comparing forest ecology and silviculture. These fields work to a considerable extent with the same subject matter — namely forest stands—but from viewpoints that are extremely different. The ecologist looks into things with the neutral question: How are they and why are they the way they are? The silviculturist's concern is to find out how forest stands can be treated to advance human purposes. Thus basic and very important differences between these two fields become visible, comparable for instance to those between anthropology and medicine or zoology and animal husbandry. The different fields can stimulate each other tremendously. However, to what extent they do this depends, especially in forestry, largely upon special efforts of the representatives of these fields to focus their work on certain urgent problems.

It seems to me that so far the steady repetition of the well known, easy going definition "Silviculture is applied Ecology" has veiled the real connections rather than made them apparent. Ecology is one of the fields that can furnish very valuable knowledge to the science silviculture, which is concerned with the possibilities of treating forest stands to meet human needs.

Answer five: We all have to keep in mind that special efforts are needed to focus our work on the most urgent needs and to combine our efforts and knowledge. This does not work automatically nor as easily as, for instance, the definition quoted above might indicate.

The Concern of All Foresters

The most dangerous cliff on the track toward progress is the belief found on the side of the practitioners as well as the men working in experiment stations and forestry schools that research is exclusively a matter of workers especially employed for this purpose. If this were true we would not need so many forestry schools, since we would not need so many academically trained foresters.

It is a fact recognized throughout the world that university trained foresters are needed because the task of forestry requires a continuous scientific approach, not the least by the foresters on the ground. To me the idea is nothing but grotesque that the few men who in California work full time in silvicultural or managerial research, including those working in related fields, could cover this field sufficiently and provide recipes for treating the stands properly under the almost discouraging variety of conditions. These few cannot now and they never will be able to in the future. Whoever agrees on this must agree that a big job of research has to be done by the foresters in the field, exactly as is done by engineers, physicians, and others in their professions.

Here are some examples of what I have in mind: There is so much

talk about survival. Who can judge better what might be responsible for good or poor survival than the man who has the responsibility on the ground? To find out, one must be well acquainted with what preceded the planting job and how it was done and must watch the seedlings closely throughout each year, year after year. Then it usually becomes obvious what significance the different factors have, such as condition of the planting stock, time of planting, technique, site, and weather. Who knows better where and in what pattern natural reproduction comes in and how it behaves on different sites under different degrees of shade than the field forester? Who knows better how and to what extent logging damage can be avoided than the forester who knows the terrain, marks the trees, and organizes and supervises the logging operation?

There is no better nucleus for progress in forestry than the knowledge and skill of broadly trained and locally experienced foresters.

We hear much complaint about how detrimental the fast transfer of foresters is for public relations. I do not believe that this is the main point. The fast transfer is much more detrimental silviculturally. Things in the field are not as easy as many people seem to think. What has been accomplished silviculturally is usually not very obvious. Very often it is the less obvious the better it has been done. Nothing is more disappointing to a field forester than when his superiors do not realize his silvicultural difficulties, efforts, and accomplishments.

In forestry it takes long years of untiring efforts consisting of most careful observations, note taking, comparisons, and reasoning before local experience can become fruitful knowledge. Any silvicultural treatment applied in the normal run of forest management must serve simultaneously as an experiment to be followed up year after year. These are the reasons why university trained foresters are needed. And this properly done is research; it has all the characteristics which research has by definition. Sometimes it is contemptuously called "just empiric." Well, we are always quite busy in screening things with words. This is one of our main weaknesses. The most important presupposition for research is intellectual integrity. It does not matter by whom or where it is used to increase our knowledge and to solve our problems.

I dare predict that the ways and means by which progress has been made in the field of agriculture, and will be made in the future, will be our ways and means to a very limited extent only. Our treatments themselves will always be rather rough ones if we compare them with horticultural and agricultural treatments. However, it is a superficial judgment to assume they are therefore easier to study and to apply. The highest level we can reach is to be able to accomplish everything just by cutting trees; however, great delicacy and refinement comes in because we have to do the rough things at the right place, at the right time, in the right amount, and in the right combination. To find out what is right and why requires research for which the field needs to be our laboratory.

Answer six: We have to be much more aware of the difficulties the field foresters have to deal with and have to give more credit to those who handle the silvicultural part of forest management successfully. Any practicing forester should feel obliged to contribute to the knowledge of our profession and should not expect other people to do the main thinking on his problems. His permanent and close contact with the forest stands provides him with opportunities other people do not have.

Many foresters probably will reply to this by saying: "We do not have enough possibilities of making the observations needed because the treatments applied in our forests are—due to whatever reasons—too far from furnishing worthwhile study objects." This is true to a considerable extent.

Small Scale Experiments Needed

I come here to the most important point I would make. I can both understand and appreciate the attitude of owners and forest managers who hesitate to apply on an operational scale treatments the suitability or profitability of which have not yet been sufficiently proved. It seems to me, however, that there is frequently a discrepancy between what is done for progress in the plants and what in the forests. In the plants are maintained departments for development and experimentation to rationalize the work and improve the products. Very, very seldom will you find comparable efforts in the forest.

Why not use one percent of a forest holding as a department for development, where treatments may be applied that are far enough advanced to be urgently recommended by the foresters. In addition to releasing this one percent for well known progressive treatments, each forester should be given some space for really new developments.

In the past some substantial efforts were made in California in planting trees on a large scale. Their frequent failure is well known. Some of these efforts represent just the opposite of what I am recommending. For successful planting and direct seeding many small things have to be considered. Experience is needed and great care. This is not identical with high cost. Men who know the job can do it relatively cheaply if they are allowed to build up a working system and a good crew, to get seedlings of their own choice, and to be flexible enough that they can adapt their work to the conditions of the season and the site.

Any forester who wants to do this should be allowed to grow his own stock on a small scale and to go ahead continuously with some planting and seeding. He should be allowed to do many other things, again on a small scale. This is the best way for progress. This is furthermore the only way to keep the forester's professional attitude in

shape, to improve his knowledge and skill, and thus to make him ready for the task ahead. How can an engineer or a physician be expected to remain an engineer or a physician or to improve his knowledge without being allowed to apply it at least on a small scale? I think we all agree that our skill to grow trees has not caught up with our skill to cut and utilize them.

Answer seven: By realizing that silvicultural progress requires intensive field work and therefore by giving foresters the opportunity to apply and increase their knowledge and skill by different kinds of small scale experimental treatments of forest stands.

Evaluation of Logging History

It seems to me that on the side of the foresters, too, a certain change in attitude would be very helpful. I am thinking of two different matters. The first one is this: I may be mistaken, but have the impression that to a considerable extent opportunities are being overlooked which lie in the evaluation of a logging history of a hundred years. The less foresters of an active temperament are allowed to do what they think future productivity of the land requires, the more they are inclined to set up study "plots." Here, then, they get the satisfaction of having at least something under close observation or to dream about. Nothing is wrong with dreams. Any professional man needs dreams to keep his attitude in shape. All over the world good forestry has been the materialization of dreams of progressive foresters.

However, let us check to see if more of our plot work ought to be focused on the evaluation of what happened in the past rather than on future development. The interpretation of what has happened in the run of a hundred years of logging can very likely quite rapidly provide much useful knowledge. And here again the forester should not wait for other people to do this on the property for which he is responsible As opposed to the evaluation of the past, plots focused on future development may take a very long time before they can furnish useful knowledge. The number of such plots has to be limited because of the heavy and long term work load involved. The applicability of the knowledge gained may therefore be very limited.

Answer eight: By using for systematic evaluation the multitude of possibilities which have been furnished by a hundred years of logging in California. We are dealing with accumulated material which by analysis and interpretation can furnish, relatively rapidly, a substantial amount of useful knowledge.

Old Growth and Silviculture

The second needed change in foresters' outlook is a certain attitude towards old growth which, I assume, is at least partly due to the tax system and to efforts of the man responsible for the engineering part of the logging operation to avoid involvement in silvicultural considerations. To the extent that silviculturally interested and conscious foresters are dealing with conditions (whatever their cause) where they cannot influence this attitude and the resultant destructive procedures, I will not argue. Nobody can do more than to make his points honestly clear according to the standard of his profession.

However, it seems to me that there are not a few foresters who agree that cutting and starting out again to grow a new crop on a more or less empty field is generally the right thing to do. This model is certainly the easiest one to work with in textbooks on economics. It is neither the only one nor always the best one. As far as California is concerned it seems to me that it is for large areas of this region the most destructive approach thinkable.

This thinking in terms of stand rotation and new starts makes us overlook the mouldability of what we have on the ground and nourishes an attitude toward old growth management by which we may miss highly valuable opportunities. I am definitely opposed to the opinion that second growth management will be much more interesting than old growth management, as I have been told repeatedly. I may quote G. A. Pearson: "It is generally agreed that silviculture begins with the first cutting, but there are those who would postpone an aggressive silvicultural program until all the old timber has been harvested. Really it should begin in the virgin stand."

If I had to decide on the tax system I would remove all regulations that foster heavy cuts and would give substantial tax premiums for light cuts and logging practice sufficiently focused on future productivity. If I am right that the tax system induces heavy cuts because one must remove at least 70 percent to avoid further timber tax, then I must say that this is one of the two most serious obstacles to progress in California silviculture. (The other one, I am afraid, is deer damage.)

Answer nine: By realizing the opportunities of maintaining productivity through light cuts and careful logging in old growth stands which allow such procedures, and by emphasizing opportunities in whatever direction such emphasis might help us accomplish better management of old growth.

Practitioner-Scientist Cooperation

For *answer ten*, the last answer to my topic, I will combine what I have said about the very limited possibilities of the few men working full time on research in silviculture, forest management, and closely related fields on one hand and the possibilities and obligations as I see them of the forest owners and their foresters on the other. If these two groups can work together in the future with the attitude toward silviculture I have tried to point up, then I daresay fast progress in California silviculture is guaranteed.

Let us not forget that the cooperation between practitioners

and scientists so often demanded does not work automatically either. It requires a special attitude as well as strong efforts by both sides to make it work. In this respect, too, very promising nuclei exist in California but the basis is not broad enough by far. If we are not very watchful the efforts for cooperation may turn out so that the main interest is focused on a few widely advertised projects and that the bulk of the practitioners will expect "the answers" to come from there. Who guarantees that they will get the answers or the right ones?

If things go that way, such projects might have a paralyzing rather than a stimulating effect. What we need is a much broader basis. Principally, any forest owner and professional forester concerned with the management of forests has to join this cooperation. Their first step should be to get busy with their own problems. No better contribution to cooperation exists. From the very moment when the owners can make up their minds to release the small working space their foresters need in order to remain foresters and to improve their knowledge to the benefit of their employers we can date a new age of California silviculture.

Then, too, and only then, we will have a sound basis for broad cooperation between everyone interested in silviculture, because we then will not be confined any longer to talking about what could be done and should be done. We then can demonstrate and discuss many different things which really have been done under the wide variety of California conditions, and that under the full control of foresters.

This will multiply the efficiency of those who are employed for research and teaching because of the availability of many differently treated stands for scientific evaluation and demonstration. Instead of the endless chain of misunderstanding due to the lack of well controlled treatments of forest stands we can start out from a sound basis and the practitioner will be in a much better position to evaluate the scientist's comments critically. This in turn is educational for the scientist.

Indeed, the practicing forester should be eager to get other professional foresters' criticism although the scientist needs this even more. This is true in forestry probably more than in any other field because of the extremely difficult process of arriving from the neutral knowledge of the basic fields at the specific knowledge required for forest management.

A.I.W.E. Conducting Membership Requirements Survey

The membership committee of the American Institute of Wood Engineering is conducting a survey of forestry school officials and of its members, as an aid in establishing membership requirements for the professional society. This activity is considered an important function of the new society, for membership requirements in a professional society serve to define the profession which that society represents.

For some years forestry school officials have been wrestling with the problem of gaining agreement on, and standardizing curricula in wood or forest products technology, utilization, or engineering. As a first step in its survey the committee studied the catalogs of those schools that offer professional training in this field. They found no well defined, consistent pattern among the various schools.

From this study, however, it was possible to set up a skeleton of study areas that are considered basic to a good "wood tech" education. The basic sciences that underly the professional education can be classified as biological studies of wood, physical and chemical studies of wood, and wood engineering. In the applied area, graduates are expected to have a knowledge of wood processing and the wood using industries, and a limited background in forestry.

The committee proposes that A.I.W.E. set up minimum basic credit hour requirements in each major study area. A total of 32 semester hours of specialized course material is suggested as the minimum required of a graduate with a bachelor's degree. It further proposes that a 10-year transition period be provided, during which certain substitutions in course material are to be permitted. This provision is included to permit time for modification of curricula to meet the standard pattern.

The proposal further permits substitution of experience for education in some of the more applied subjects, and for the establishment of a junior grade of membership for students and others who have not yet gained full membership status.

To date A.I.W.E. has been accepting into membership graduates, with a bachelor's or higher degree, of wood technology or utilization curricula, or men who have qualified for membership on the basis of experience.

The results of the survey will be reported at the national meeting of A.I.W.E., to be held on June 28, 1959, in San Francisco in connection with the national meeting of the Forest Products Research Society.

The membership committee of A.I.W.E. consists of A. F. Muschler, R. L. Youngs, and H. O. Fleischer, chairman.

Road and Slope Characteristics Affecting Sediment Movement from Logging Roads

Harold F. Haupt[1]

LOGGING ROADS ARE frequently a source of damaging runoff and sediment, especially on steep sloping forest lands. Although adequate facilities, such as cross ditches, dips, and outsloping, can be installed to protect the road surface, the concentrated runoff (from the road surface) commonly causes serious erosion of the fill or the embankment slope. Unless this runoff is controlled downslope, it may carry excessive quantities of sediment into channels or erode and otherwise damage other roads traversing the same slope. The acuteness of this problem is greatest the first few years after road construction while embankments are still loose and bare of vegetation.

Natural or artificial revegetation of the roadway eventually provides some degree of erosion control as the plant cover thickens, but at best, revegetation does not eliminate the need for controlling concentrated runoff. Two immediate means of solving this road drainage problem are available. One is to install open culverts, water-drop structures, paving, and diversion trenches to carry water away safely to protected areas. This measure is expensive considering the great amount of roadway to be expected on a logging area[2] and the large number of control installations needed. Another solution is to reduce runoff from road surface and then have enough natural slope distance below the road embankment over which the surface runoff and erosion may be dissipated before reaching lower roads or channels.

This article reports a study designed to determine the length of slope required to dissipate this drainage from logging roads situated on steeply sloping granitic soils in southwestern Idaho. This type of terrain is characteristic of many ponderosa pine lands in the West. The area selected for study is located within the Little Owl Creek watershed of the Boise River basin and was logged in 1955. In 1956 it was covered by an unusually heavy snowpack, and a hard spring rain fell while the soil mantle was still wet from the melted snow.[3] Seepage from the heavy snowmelt concentrated on the roadways. Wherever it was diverted, it carved gullies in the fill slopes and deposited granitic material at great distances below the road and in stream channels (Fig. 1). The rapid runoff from the gullies enlarged by the spring rainstorm extended the earlier sediment flows further downslope. If additional storms were to occur prior to the healing of these gullies on the fill slopes, more sediment would be produced and would lead to even further extensions of sediment flows. Evidence at hand strongly indicates that such a situation is likely to occur infrequently. For this reason, this paper reports sediment movement representing the maximum that would occur under climatic conditions just short of a catastrophe.

Plan of Study

The distance sediment flows from

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[1]The author is grateful to Dr. D. W. Lynch for generous guidance with the statistical analyses and to W. J. Kidd and D. W. Thorud for assistance in collecting and analyzing field data.

[2]Haupt, H. F. Soils bared on ponderosa pine lands (in preparation).

[3]U. S. Forest Service, Climatological records, 1955-56, Boise Research Center (unpublished). See also U. S. Weather Bureau, Climatological data 1955, Idaho Sec. 11:141; 12:155; and U. S. Weather Bureau, Climatological data 1956, Idaho Sec. 1:1; 2:15; 3:29; and 4:41.

FIG. 1.—Excessive deposition of fill slope material in an ephemeral stream channel.

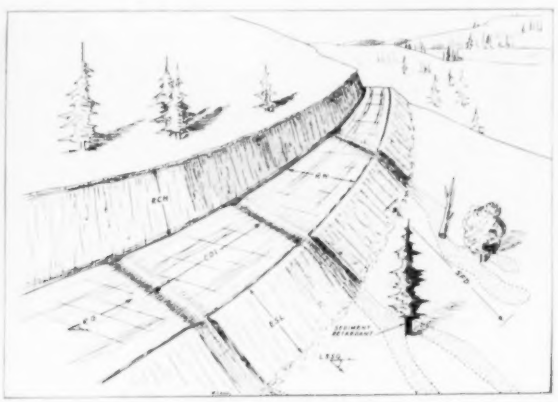

FIG. 2.—Schematic view of sediment flow distance and road and slope characteristics under investigation. *Sfd*—sediment flow distance; *Rw*—Road width; *Rg*—road gradient; *Cdi*—cross ditch interval; *Esl*—embankment slope length (actual); *Rch*—road cut height (vertical); *Lssg*—lower side slope gradient.

a road embankment downward and onto the intervening area ("protective" strip) between the road and stream was assumed to depend on three major factors: the amount and velocity of road surface runoff the volume of sediment material available, and downslope resistance to sediment movement. The study was confined to 75 sections of new haul road "put-to-bed" in the fall of 1955, in accordance with the standard practices of cross ditching and removing temporary culverts.

A road section was chosen for this study if (a) it represented an interval of road between effective cross ditches; (b) it was not affected by "outside" runoff, i.e., runoff from intersecting skidtrails or side draws; (c) its cross ditch drainage discharge caused a measurable movement of sediment downslope, i.e., had not been trapped in a slough crevice on the road embankment; and (d) this sediment movement dissipated before reaching a channel or downslope road.

In selecting variables thought to be related to the causes of sediment movement downslope, road width, cross ditch interval, road cut height, road gradient, embankment slope length, slope obstruction index, and lower side slope gradient were chosen for study. Soil physical characteristics such as permeability and texture were not chosen because they are not readily susceptible to control or to consideration by a road planner.

The way in which these seven variables are believed to influence amount and velocity of runoff, sediment availability, and the ease of sediment movement downslope is shown below:

Amount and velocity of runoff	Road width (*Rw*) Cross ditch interval (*Cdi*) Road cut height (*Rch*) Road gradient (*Rg*)
Sediment availability	Embankment slope length (*Esl*)
Ease of movement downslope	Slope obstruction index (*Soi*) Lower side slope gradient (*Lssg*)

Road width, cross ditch interval, and road cut height commonly delimit the total ground surface within a study section capable of receiving, concentrating, and discharging precipitation falling thereon or seepage flow emanating from the road cut bank. Road gradient influences the velocity of runoff from the road surface. An increase in runoff velocity causes a greatly increased cutting and transporting power that is especially severe in loose embankment material. Accompanying this increase in sediment dislodgment would be greater opportunity for downslope sediment movement. Embankment slope was chosen because earlier observations had shown that the road fill was a major source of downslope sediment. This characteristic, therefore, was expected to indicate the volume of potentially available sediment. When sediment is moved downward from either the road surface or an embankment slope, two other factors were believed to influence its dissipation: slope obstruction index, and lower side slope gradient. The slope obstruction index, a calculated value, is explained in detail in the following section. Lower side slope gradient is similar to the road gradient in its influence on velocity and distance of sediment movement below the embankment slope.

Measurements

Sediment flow distance downslope and six other road and slope characteristics (Fig. 2) were measured and recorded for this study. The distance of sediment flow was measured from the toe of an embankment slope to the furthest point downslope and recorded to the nearest foot. Measurements of the road cut height, embankment slope length, cross ditch interval, and road width were also recorded to the nearest foot. Gradients of the road surface and of the lower side slope were measured with an Abney level and recorded to the nearest percent.

Slope obstruction index (*Soi*) is a calculated value. To derive *Soi*, a rating scale was devised to quantify the slope retardants. Each major obstruction that actually caused some retardation of flow was given a numerical rating of 1. These obstructions included standing trees, down snags, logging slash and fallen branches greater than 3 inches in diameter, rock outcrops, clumps of brush higher than 2 feet, tree stumps, hummocks, and natural depressions. If the interspace ground cover consisted of grass or grasslike plants commonly found under parklike stands of ponderosa pine on southerly exposures, an additional value of 1 was added to the sum of the retardants. A value of 2 was added if the interspace cover consisted of soft low brush not more than 2 feet high. Values for the surface retardants were totaled and divided into the sediment flow distance to give the slope obstruction index (Fig. 3). Thus, a large *Soi* indicates that slope obstructions either are lacking or are spaced far apart.

The ranges of values obtained for each variable, and their arithmetic means are summarized in Table 1. Of the variables evaluated, only sediment flow distance and the slope obstruction index have a skewed distribution of values around the mean. *Sfd* values ranged from 3 to 369 feet, although all but 9 values were less than 120 feet. Similarly, the range of *Soi* values varied from 1 to 106, while all but 4 of these values were less than 36. Few *Sfd's* longer than 120 feet were measured in the study area because roads were close to one another or because stream channels intercepted or otherwise obscured longer distances.

Characteristics Affecting Sediment Movement

To relate sediment flow distance to road and slope characteristics considered in this study, a multiple regression equation was set up in which six characteristics singly, six in combination, and two raised to an exponent were tested. The equation is:

$$Sfd = b_0 + b_1\,(Soi) + b_2\,(Cdi) + b_3\,(Esl) + b_4\,(Rg) + b_5\,(Lssg) + b_6\,(Rw) + b_7\,(Cdi \cdot$$

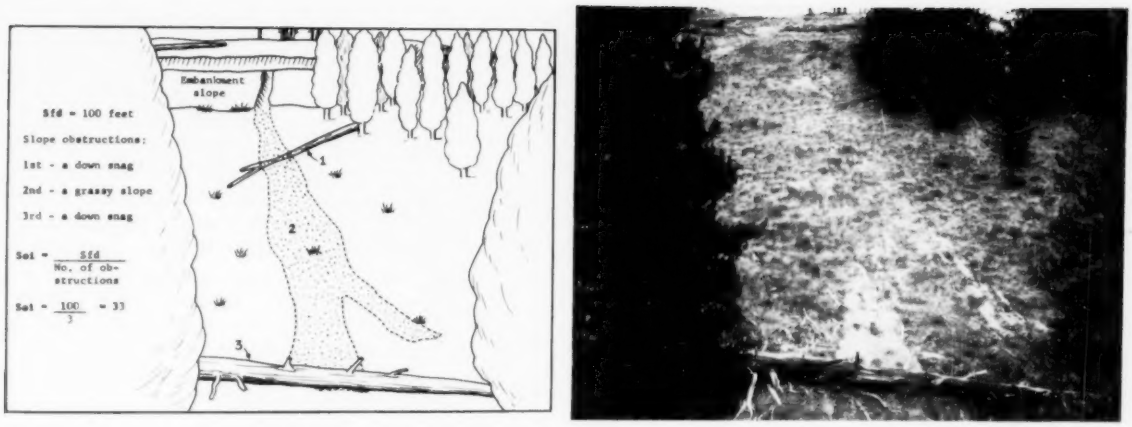

FIG. 3.—View of a sediment flow distance showing how slope obstructions were identified and used to derive the slope obstruction index.

$Rg) + b_8 (Rw \cdot Cdi) + b_9 (Esl \cdot Lssg \cdot Rch) + b_{10} (Cdi^2) + b_{11} (Rg^2)$.

Solution of this equation by the method of least squares using data from 75 road sections gives sediment flow distance in feet. The slope obstruction index is the characteristic most highly related to sediment flow distance; it is followed in order by cross ditch interval squared, embankment slope length, and the product of cross ditch interval and road gradient. Contribution of each of the variables is shown in Table 2.

The importance of these four variables can be explained, in part, by what is known of the hydraulics of erosion and mechanics of control. The high positive relationship of the slope obstruction index is explained by the marked effect that numbers, kinds, and spacing of surface obstructions have in slowing the flow of sediment. Lower side slope gradient was not significant as a control over sediment movement, contrary to expectations. This is attributed to the disruptive influence of the obstructions already mentioned in connection with the slope obstruction index. Had obstructions other than grass or low brush not been present, the gradient factor might have shown significance. The lack of significance of downslope gradient in this study is contrary to results reported by Trimble and Sartz[4] for a northern hardwood forest. They concluded that downslope gradient was the key in determining the distance sediment moved from roads without testing the influence of other characteristics.

[4]Trimble, G. R., and R. S. Sartz. 1957. How far from a stream should a logging road be located? Jour. Forestry 55: 339-341.

TABLE 1.—SUMMARY OF MEASUREMENTS OF ROAD AND SLOPE CHARACTERISTICS THAT AFFECT SEDIMENT FLOW DISTANCE

Variable	Range of measurements 100 percent	Approx. 67 percent	Arithmetic mean
Road width (feet)	12-27	14-18	16.5
Cross ditch interval (feet)	51-192	84-133	106.1
Road cut height (feet)	1-9	4-6	5.3
Road gradient (percent)	0-17	4-8	6.3
Embankment slope length (feet)	1-32	6-18	12.2
Slope obstruction index	1-106	3-24	13.8
Lower side slope gradient (percent)	11-73	30-59	45.6
Sediment flow distance (feet)	3-369	9-117	63.2

TABLE 2.—ANALYSIS OF VARIANCE SHOWING THE CONTRIBUTION OF EACH OF THE EQUATION VARIABLES IN RELATION TO SEDIMENT FLOW DISTANCE

Source of variation	Degrees of freedom	Sum of squares	Mean square	F-value
Regression constant, b_0	1	299,063	299,063	132.3**
Added effect of *Soi*	1	129,681	129,681	57.4**
Added effect of Cdi^2	1	77,624	77,624	34.3**
Added effect of *Esl*	1	26,485	26,485	11.7**
Added effect of $Cdi \cdot Rg$	1	17,792	17,792	7.9**
Added effect of *Rg*	1	6,163	6,163	2.7
Added effect of Rg^2	1	3,076	3,076	1.4
Added effect of *Lssg*	1	364	364	
Added effect of $Esl \cdot Lssg \cdot Rch$	1	409	409	
Added effect of $Rw \cdot Cdi$	1	58	58	
Added effect of *Cdi*	1	5	5	
Added effect of *Rw*	1	4	4	
Residuals	63	142,434	2,261	
Total	75	703,158		
Regression constant, b_0	1	299,063	299,063	137.2**
Added effect of *Soi*	1	129,681	129,681	59.5**
Added effect of Cdi^2	1	77,624	77,624	35.6**
Added effect of *Esl*	1	26,485	26,485	12.2**
Added effect of $Cdi \cdot Rg$	1	17,792	17,792	8.2**
Residuals	70	152,513	2,179	
Total	75	703,158		

**Significant beyond the 1 percent level.

Second in descending order of importance is cross ditch interval squared; it indicates that an increase in *Sfd* is not a straight line relationship with cross ditch interval; it becomes increasingly greater as the interval is lengthened (Table 2); this indicates the superiority of this variable over others as an index of road surface area. The range in road width values was probably too narrow to provide a complementary relationship when multiplied by the "length" dimension.

Cross ditch interval value multiplied by road gradient reflects significantly the combined influence of volume and velocity of runoff on the eroding power of a diverted discharge. This combination is only slightly superior to *Rg* tested separately (Table 2).

The statistical importance of embankment slope length substantiates the assumption made in the beginning that the road fill is a major source of sediment that moves downslope. However, the lack of stronger statistical significance suggests existence of other sources of sediment. For example, occasional road surface discharges remove material from the embankment slope and still possess sufficient energy to erode a thinly grassed slope and make it an additional source of sediment. Note the gullies on the protective strip in Figure 1. Contrary to what might be expected, hardpacked road surfaces contributed only a minor amount of sediment as evidenced by very little visible erosion.

Development of the Estimating Equation

The average relation of sediment flow distance to the four dominant road and slope characteristics is shown by the regression equation:

$$Sfd = 1.2871\ Soi + .0030\ (Cdi^2) + 3.4918\ Esl + .0468\ (Cdi \cdot Rg) - 66.2395$$

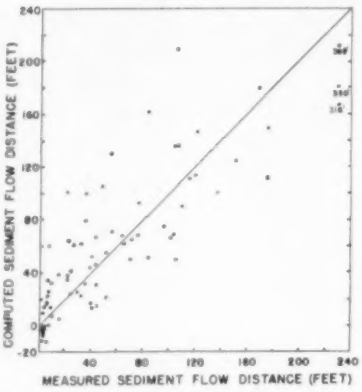

FIG. 4.—Relation of computed sediment flow distance to measured sediment flow distance.

which has a standard error of estimate of 46.7 feet. This equation indicates that variation in indexes of road and slope characteristics explains 78 percent of the variation in the sediment flow distance for the road sections selected for study.

To afford a comparison of actual and estimated values, sediment flow distances computed from the equation are plotted against measured sediment flow distances in Figure 4. Because the equation is an expression of average effect, some computed sediment flow distances differ materially from measured distances where variables are near range limits. Except for this weakness, common to most estimating equations, this equation provides a systematic method of estimating the minimum width of buffer strip required to dissipate road drainage and stop sediment movement. Because the two variables, slope obstruction index and embankment slope length, cannot be determined directly at the time of road location, they must be determined by indirect methods. For practical application, the *Soi* of a slope is about equal to the average spacing (in feet) of major obstructions along the direction of the slope. Supplemental equations were derived to relate *Esl* to side slope topography, a factor measurable at the time of road location.

Further description of the field application of the estimating equation is beyond the scope of this paper. A subsequent publication will include various detailed procedures and examples for planning the location and treatment of new roads. It is believed that results of this study will be of direct aid in reducing sedimentation from new haul roads by providing better criteria for road location and erosion control in areas characterized by granitic soils and subjected to climatic events not unlike those of southwestern Idaho. A similar approach should be beneficial in other timbered areas where high watershed values need to be maintained.

Summary

The amount of erosion and sediment occurring below logging roads on steeply sloping granitic soils in ponderosa pine lands of southwestern Idaho was studied intensively. Seven road and slope characteristics amenable to quantitative evaluation were investigated to determine their relationship to the distance that sediment moved downslope from a road embankment. Four of these characteristics —the slope obstruction index, cross ditch interval squared, embankment slope length, and the product of the cross ditch interval and road gradient—were found to influence sediment flow distance significantly. These characteristics were incorporated into an equation that promises to be valuable in determining the safe width of buffer strips necessary to protect lower roads or stream channels from sediment damage emanating from road construction activities.

Cleaning to Favor Western White Pine—Its Effects Upon Composition, Growth, and Potential Values

Raymond J. Boyd

THE MANAGEMENT OF western white pine (*Pinus monticola*) requires the production of a high proportion of valuable white pine crop trees in order to defray the costs of protection from blister rust. Current average selling prices of lumber give white pine about $50 per m.b.f. advantage over western larch (*Larix occidentalis*) and Douglas-fir (*Pseudotsuga menziesii*), the next most valuable species common to the type. On the average site, yielding 50 m.b.f. per acre at 120 years of age, a 10 percent difference in white pine volume would amount to $250 per acre.

Unfortunately, the forester cannot depend upon nature to provide composition that is good from a financial standpoint. Occasionally nearly pure stands of white pine are found, but they are exceptional. Ecologically white pine is a seral tree growing with a number of other species. It generally reproduces quite well, but can be suppressed by faster growing intolerant species or advanced reproduction of more tolerant species, all of which reproduce more abundantly than white pine (*2*). Western larch, a very common associate, and lodgepole pine (*Pinus contorta*) outstrip white pine in height growth by 1½ times during the first 30 years of a stand's life. Larch retains some height advantage until maturity. Lodgepole pine slows down by the 50th year and is soon overtopped by white pine. Grand fir (*Abies grandis*) height growth is equal to that of white pine during this period, and Douglas-fir growth nearly equals that of white pine. Ordinarily western hemlock (*Tsuga heterophylla*) grows much more slowly than white pine, but on north aspects and under a partial overwood both hemlock and grand fir equal or outgrow white pine.

During the first 30 years of the life of white pine stands, the composition of the mature stand is formed from the diverse reproduction that survives the regeneration period. Growth and yield studies in the white pine type show that stand composition does not change materially between the 30th year and the rotation age of 120 years (*3*). Cleaning to improve stand composition has its best chance of success at the least cost during the early portion of this formative period. Undesirable species can be removed with the least effort, and desirable crop trees can be given a full measure of growing space before competition and age reduce their tolerance and vigor.

Two cleanings were made in 1935 in stands typical of many reproduced areas of the Inland Empire. Both of these stands were approximately 30 years old at the last remeasurement of the tests; so their composition should be fairly well established. The stands were cleaned by CCC labor using hand pruners. The cleanings required from one to four man-days per acre.

Prior to remeasurement of the plots 20 years after treatment, stand composition was judged on the basis of milacre quadrat stocking. This was necessary because of the difficulty of determining crown classes in juvenile stands. In using this measurement method the tallest tree on each quadrat was considered the dominant tree for that unit, and the sum of these unit dominants was considered the dominant stand. The percentage of these stocked quadrat units on which western white pine was the dominant tree was the measure of the effectiveness of cleaning in improving composition. Twenty years after cleaning, the crown classes were sufficiently discernible so that conventional stand tallies by crown classes were made.

Kaniksu Study

This study is located in the Upper West Branch Drainage of Priest River in the Kaniksu National Forest, Idaho. It tests the development of well stocked white pine when released from a competing stand composed primarily of western larch and lodgepole pine. The stand originated after the old growth was burned in 1926. Stand density on the study plots ranged from 9,000 to 21,000 trees per acre, with an average of 13,000.

The plots were located on a level bench. The soil is clay loam in texture to a depth of about 2 feet underlain by a clay hardpan.

The test was established in 1935 when the stand was eight years old and consisted of three 0.4-acre plots treated as follows:

Heavy cleaning.—All trees higher than 0.5 foot except white pine and redcedar were cut.

Moderate cleaning.—All white pine and cedar trees were left. Larch trees within 8 feet of a white pine were removed and Engelmann spruce (*Picea engelmannii*) and Douglas-fir trees were cut only when crowding white pine. In the absence of white pine, smaller larches were left and given an 8-foot spacing.

Check.—Uncleaned.

On a milacre stocking basis, moderate cleaning increased the proportion of white pine in the dominant stand from 1 percent before cleaning to 45 percent after cleaning. On the heavily cleaned plot the increase was from an initial 9 percent to 70 percent. Cleaning reduced the densities of the trees taller than 0.5 foot by approximately 70 percent on both the moderately and heavily cleaned areas,

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TABLE 1.—PROPORTION OF WHITE PINE IN THE KANIKSU NATIONAL FOREST CLEANING PLOTS 20 YEARS AFTER TREATMENT

Treatment	White pine in total stand	White pine in dominant stand		White pine in largest 200 trees per acre	
		Number stems	Cubic volume	Number stems	Cubic volume
	Percent				
Heavy cleaning	19	61	76	81	86
Moderate cleaning	22	30	39	40	45
Uncleaned	6	0.5	0	0	0

and left cleaned stands of about 2,800 stems per acre.

Results. — Composition results from this study at the end of the fourth and ninth years after cleaning have been reported by Wellner (*4, 5*). During this period larches shorter than 0.6 foot in height grew rapidly enough to overtop many of the white pines that had been placed in a dominant position by cleaning. Nevertheless the white pine, having less competition, showed great changes in its development after being released. After four years the pines on the weeded plots were stocky with dense blue-green foliage as compared to the slender sparse dark green foliage on pines in the uncleaned plots. Weight of foliage per seedling, on an ovendry weight basis, as well as stem diameter, was half again as great on the weeded plots as on the unweeded. No differences in pine height growth during the first four years were apparent, but by the end of the ninth year the average height of white pine on the heavily cleaned plots was nearly three times that on the check plot, while the pines on the moderately cleaned plots were nearly twice as tall as their unweeded contemporaries.

Measurements made 20 years after cleaning show that in spite of the rapid response of small residual larch seedlings left, desirable composition has been maintained (Table 1). In terms of the total stand, cleaning has had only a small effect on white pine composition. Approximately 20 percent of the total number of stems are white pine in the cleaned stands compared to 6 percent in the check stand. In terms of the percentage of white pine in the dominant crown classes, cleaning has been very effective. On the check plot larch and lodgepole pine have maintained their original height superiority with the result that white pine constitutes less than 1 percent of the dominant stand by number of stems and by cubic volume. The dominant stand on the heavily cleaned plot is high value white pine: 61 percent of the stems and 76 percent of the volume. Improvement in composition has been only about half as effective in the moderately cleaned stand, where 30 percent of the dominant trees and 39 percent of the dominant volume are white pine.

Judging the effects of cleaning by an analysis of composition of the dominant stand was somewhat complicated because of the disproportionate number of trees per acre rated as dominant or codominant on the various treatments. Therefore the same proportions were calculated for the 200 largest trees per acre. The effects of cleaning upon composition of the potential crop are even more striking when the stands are so analyzed. Of these 200 trees per acre, 81 percent of the trees and 86 percent of the volume are white pine on the heavy cleaning as compared to 40 and 45 percent, respectively, under moderate cleaning. The check plot had no white pine in the 200 largest trees per acre. Thus it appears that cleaning has actually been more effective than might be indicated by a compositional analysis of the dominant stand.

Although the primary objective of cleaning is to improve species composition, the reduction in stand density that results from cleaning can promote additional benefits. As was stated earlier, the cleaning operation on these plots resulted in a 70-percent reduction in stocking of the stand above one-half foot in height. What effect did this reduced stocking have on stand volume and tree size? The total stand volume on the check plot 20 years after treatment was 917 cubic feet compared to 949 cubic feet on the moderate cleaning and 1,271 on the heavy cleaning. Measurements of the 200 largest trees per acre showed greater differences: 355 cubic feet on the check plot, 402 cubic feet on the moderately cleaned plot, and 623 cubic feet on the heavily cleaned stand. These differences reflect the differences in the average diameters of the 200 largest trees, which increase by approximately 0.5 inch for each degree of weeding.

Deception Creek Study

This set of nine plots, located on the Deception Creek Experimental Forest, was established in a 16-year-old stand composed primarily of grand fir, western hemlock, and western white pine. The stand originated from a 1916-1918 seed tree cutting. Hemlock and grand fir had been girdled at the time of logging so as to leave a white pine seed tree stand. Seed trees were removed in 1935 when the stand was cleaned. This stand is situated on a middle and lower slope with a northerly aspect. The soil is a residual stony loam with loessal admixture, about 2 feet deep, underlain by fractured quartzite.

The study consists of three blocks of three 1/10-acre plots, two cleaned and one uncleaned in each block. White pine reproduction was well distributed on the plots and averaged 1,300 seedlings per acre with a milacre stocking of 74 percent. The number of white pine seedlings ranged from 750 to 3,200 per acre and the stocking from 62 percent to 85 percent. Only 21 percent of the stems were white pine on the average; the remainder were largely advanced hemlock and grand fir in a dominant position with respect to the white pine. Larch, cedar, and Douglas-fir were minor components of the stand.

The cleaning removed an average of 76 percent of the original stand above 0.5 foot in height, leaving the best white pine seedlings

spaced at a minimum of 4 feet. The proportion of white pine was raised from 21 to 81 percent. Practically all seedlings other than white pine were cut unless they were needed to provide good crop tree distribution in the absence of pine. Fifty-four to 80 trees were marked as crop trees on each plot. Nearly pure stands of white pine crop trees were left on blocks A and C, but on block B, 20 percent of the "crop trees" were grand fir.

Results. — Twenty years after cleaning, white pine had maintained the original advantage given to it in the cleaning operation (Table 2). The present proportion of white pine in the dominant stand (78 percent) closely approximates the proportion that was left by the cleaning operation (81 percent). Ingrowth and seeding in of more tolerant species has reduced white pine to 31 percent of the total number of stems but has not affected the dominant stand. For the complete set of plots, cleaning has resulted in nearly a 3-fold increase in the proportion of white pine in the 200 largest trees per acre.

Cleaning has not resulted in any improvement in total stand volume. The uncleaned stands have a slight superiority in total volume 20 years after cleaning, but there is no difference in total dominant stand volumes. However, white pine volume is greatly superior on the cleaned areas, averaging 1,057 cubic feet per acre as compared to 320 cubic feet per acre on the uncleaned stands. Thus, cleaning has effected more than a 2-fold increase in white pine volume.

The trees originally marked as "crop trees" on the cleaned plots were superior to equivalent "crop trees" on the check plot (Table 3). Crop tree volumes on the cleaned plot averaged 231 percent more than on the check; average diameters were 61 percent greater, and heights were 24 percent greater. In addition, mortality, caused principally by snow breakage, has been much lighter in the cleaned plots.

Analysis of the volumes and sizes of the 200 largest trees per acre shows much the same treatment influence as on the Kaniksu plots. The volume of the 200 largest trees on the cleaned plots averaged 762 cubic feet as compared to 573 cubic feet on the check. The average diameter of the largest trees was one-half inch greater on the cleaned stand (5.8 inches on the cleaned vs. 5.3 on the check).

TABLE 2.—WHITE PINE COMPOSITION 20 YEARS AFTER CLEANING, DECEPTION CREEK PLOTS

Treatment	White pine in total stand	White pine in dominant stand		White pine in largest 200 trees per acre	
		Number stems	Cubic volume	Number stems	Cubic volume
	Percent				
Block A					
Cleaned	32	91	94	95	97
Check	10	24	27	30	32
Block B					
Cleaned	34	48	73	65	65
Check	18	19	14	15	8
Block C					
Cleaned	28	94	99	100	100
Check	13	25	27	25	27
Mean all blocks					
Cleaned	31	78	89	87	87
Check	14	23	23	23	22

Discussion

Cleanings have long been advocated in the western white pine type because they seemed to promise great improvement in stand value at low expense (*1, 4, 5*). Like planting, pruning, blister rust control, and precommercial thinnings, cleanings must be made at a dead weight expense and should yield benefits in excess of their original cost.

Davis (*1*), in estimating the possible future benefits of the Deception Creek cleanings, anticipated an increase of 25 percent in white pine volume at maturity. Twenty years later measurement shows that these cleanings have resulted in white pine compositional improvement of 66 percent, far in excess of what was thought possible. In view of the negligible changes in composition that normally occur in white pine stands after the 30th year, it seems reasonable to assume that the present proportion of white pine will be maintained until the harvest age.

By applying the $250 per acre valuation for each 10 percent increase in the proportion in white pine volume yields, a final increased valuation of $1,650 per acre might result from the cleaning operation. Present-day cost of this cleaning at 1.5 man-days per acre would be about $30 per acre.

Cost and benefit values for the Kaniksu stands are comparable to those on the Deception Creek cleanings. The heavy cleaning today would cost about $60 per acre (3 man-days), and final increased valuation might amount to $1,900 per acre. The moderate cleaning would now cost about $40 per acre (2 man-days); final increased valuation might be about $975 per acre.

These potential benefits result from improvement in composition only. Should the cleaning, through an early reduction in stand density, promote greater diameter growth on the crop trees, as has been indicated, some additional benefit might be realized.

Where cleanings can materially increase the amount of western white pine in the stand, as they did in the Kaniksu and Deception Creek tests, they should aid mate-

TABLE 3.—"CROP TREE" STAND ON CLEANED AND CHECK PLOTS 20 YEARS AFTER CLEANING

	Volume	Average d.b.h.	Height	Mortality (20 year total)
	Feet	*Inches*	*Feet*	*Percent*
Cleaned	898	4.2	25.6	29
Check	271	2.6	20.6	47

rially in defraying the costs of protecting white pine from blister rust.

Summary

Results of two cleanings to favor western white pine show that: (1) compositional improvements have been maintained at a high level during the 20 years since cleaning; (2) improvement in size and volume of potential crop trees resulted from the reduction in stand densities; and (3) similar cleaning operations under current economic conditions should yield substantial economic benefits.

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Effects of Stock Plant Fertilization Upon Rooting of Cuttings of Picea abies, Pinus resinosa, and Pinus strobus[1]

L. J. Enright

IT HAS BEEN SHOWN that Norway spruce (*Picea abies*), red pine (*Pinus resinosa*) and white pine (*Pinus strobus*) may be propagated by cuttings and that the rooting of the cuttings is usually improved by treatment with root inducing substances (*1*). It has been further shown that cuttings taken in November root better than if taken in late winter, and better if taken in December than if taken in spring, summer, fall, or later in the winter (*2*). Treatments for 24 hours with solutions of indoleacetic (*5*) and indolebutyric acid (*6*) have failed to improve rooting significantly. Powder dip treatments with indolebutyric acid have caused some injury in many cases (*6*), but rooting was somewhat improved by indoleacetic acid in talc (*4*). November cuttings made with the basal cut above the base of the current season's growth and planted in a mixture of equal parts of sand and peat have rooted about 50 percent without treatment, 82 percent in 10 months after treatment with indoleacetic acid (*6*). Treated cuttings in the same experiment rooted less well in sand.

White pine cuttings, treated or untreated, have not often rooted well if obtained from mature trees, or trees more than 4 years old (*6, 7, 8*). Deuber(*2*) found that small cuttings (lateral twigs) root better than large cuttings (terminal shoots) and that winter is apparently a better time to take cuttings than spring, summer, or fall. Snow (*9*) took cuttings in August and rooted them the following summer. Best results secured were 47.5 percent rooting when the cuttings were treated with indolebutyric acid. Earlier papers by Enright (*3, 4*) reported successful propagation of *Liriodendron tulipifera* and several species of Acer from cuttings with a concentrated-solution-dip treatment with indolebutyric acid and it was decided to study the effects of the same treatment on the conifers herein mentioned.

In this work, special attention was given to (*1*) the effects of fertilizer applications to the stock plants on rooting responses of cuttings taken from those plants, (*2*) the effects of root inducing substances used for treatment of cuttings, and (*3*) the season of the year or stage of growth at which cuttings are taken.

Materials and Methods

All the seedlings used as a source for cuttings in this investigation were grown at the Maryland Forest Tree Nursery, Harmans, Maryland. The seedbeds for growing the parent stock plants were prepared in the usual manner but with the addition of cottonseed meal applied at the rate of 1,000 pounds per acre and a 4-12-4 fertilizer at the rate of 500 pounds per acre. During the early spring of their first year, the seedlings were top dressed with the same materials at the rate of 500 pounds per acre. This top dressing was prepared with a ratio of two parts cottonseed meal for each part of 4-12-4 fertilizer.

Cuttings were taken from the side branches of the trees during their third year of growth. The cuttings taken averaged 4 to 5 inches, and they were prepared with a diagonal basal cut. The cuttings were not wounded because it was found in earlier experiments that the stems became discolored and the cuttings died when the basal portions had been wounded. Cuttings were made in July, August, and September and were

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[1]Scientific Article No. A680, Contribution No. 2895 of the Maryland Agric. Expt. Sta. (Department of Horticulture).

treated with indolebutyric acid and talc (3 mg/gm talc)[2] (Treatment A); indolebutyric acid and talc (8 mg/gm talc)[3] (Treatment B) 0.003 percent 2,4,5 — trichlorophenoxyacetic acid + 0.006 percent sodium salt of alphanaphthaleneacetic acid[4] (Treatment C); 0.006 percent 2, 4, 5 — tricholorphenoxyacetic acid + 0.0012 percent sodium salt of alphanaphthalenacetic acid[5] (Treatment D); 0.1 mg/ml indolebutyric acid and water (Treatment E); 1 mg/ml indolebutyric acid and water (Treatment F); 5 mg/ml indolebutyric acid and water (Treatment G); 10 mg/ml indolebutyric acid and water (Treatment H); and 20 mg/ml indolebutyric acid and water (Treatment I).

After treatment the cuttings were put into a sand filled greenhouse bench and provided with moisture by an intermittent spray system (3,4). The mist system was timed to water the plants for 8 seconds during every 10-minute interval from sunrise to sunset.

Root systems were arbitrarily classified as light, medium, and heavy according to the number and size of the roots developed. (Fig. 1).

FIG. 1. — Typical root systems for *Pinus strobus*, *Pinus resinosa*, and *Picea abies* arbitrarily classified as to light, medium, and heavy according to the number and size of roots developed.

Results and Discussion

Most of the treatments increased the percentages of rooting of cuttings taken from fertilized trees (Table 1). These results indicate that fertilizer treatment of the parent seedling stock plants with chemical treatment of the cuttings taken from those same stock plants, will stimulate the development of a high degree of rooting. This suggests the possibility that if only older wood is available as a source for cutting wood, it may be possible to induce "juvenility" into the newer growth with a period of fertilizer stimulation.

Unfertilized cuttings rooted poorly or not at all; the best rooting without treatment was 18 percent for the Norway spruce, 26 percent for the white pine, and 4 percent for the red pine.

For some reason, the white pine cuttings treated with 20 mg/ml IBA in July failed to respond to the treatment although this same treatment produced the largest percentage of rooted cuttings in August and September. White pine cuttings were quite variable in their response to chemical treatments. The cuttings made in July and August responded to treatment with 2,4,5 TP and it may be that a more concentrated solution of this material will increase the percentage of rooted cuttings (Fig. 1).

Treatments resulting in marked increases in percentages of rooted cuttings of red pine were indolebutyric acid at 20 mg/ml and 10 mg/ml concentration. The 5 mg/ml IBA dip treatment provided some rooting response. The percentage, however, was considerably lower than that obtained from the two more concentrated formulations. The percentages rooted with the 1 mg/ml IBA treatment was still smaller. None of the other treatments resulted in any rooting response.

The best results with Norway spruce were evidenced by cuttings treated with concentrated solutions of indolebutyric acid and water. Excellent results were obtained with cuttings taken in August when they were treated with the 20 mg/ml (Table I) and slightly lower percentages of rooting were obtained from cuttings made in July and September. Treatments with 2,4,5 TP were considerably less effective, as were indolebutyric acid and talc.

White pine cuttings rooted in 51

[2]Hormodin 2.
[3]Hormodin 3. Merck and Company, Rahway, New Jersey.
[4]Rainbow Rooting Powder "Semi-Woody."
[5]Rainbow Rooting Powder "Woody," Rainbow Color and Chemical Co., North Ridge, California.

TABLE 1.—EFFECTS OF TREATMENTS WITH ROOT INDUCING SUBSTANCES ON ROOTING OF CUTTINGS OF PICEA ABIES, PINUS RESINOSA AND PINUS STROBUS TAKEN FROM DIFFERENTIALLY FERTILIZED STOCKS[1]

Treatment	Date made	Percent rooted					
		Picea abies		*Pinus resinosa*		*Pinus strobus*	
		Fertilized	Unfertilized	Fertilized	Unfertilized	Fertilized	Unfertilized
Untreated	July 16	6	0	0	0	4	0
A		22	0	0	0	20	0
B		12	0	0	0	36	0
C		8	0	0	0	38	0
D		14	0	0	0	18	0
E		20	0	0	0	6	0
F		48	0	4	0	14	0
G		66	0	20	0	40	0
H		72	8	56	0	84	6
I		78	14	84	0	0	0
Untreated	August 20	14	0	0	0	10	0
A		38	0	0	0	24	0
B		20	0	0	0	32	10
C		8	0	0	0	40	0
D		20	0	0	0	16	0
E		28	0	0	0	28	0
F		54	2	0	0	42	8
G		70	2	28	0	68	12
H		82	8	66	0	74	10
I		94	18	82	4	86	16
Untreated	September 15	4	0	0	0	18	0
A		40	0	0	0	24	0
B		24	0	0	0	16	0
C		8	0	0	0	12	0
D		12	2	0	0	12	0
E		24	0	0	0	36	0
F		64	0	24	0	42	0
G		52	4	56	0	72	0
H		50	10	78	0	88	12
I		88	16	86	0	92	26

[1]Based on 50 cuttings per treatment.

to 58 days; red pine cuttings in 66 to 78 days and Norway spruce cuttings in 53 to 61 days.

Summary

Cuttings of *Picea abies*, *Pinus resinosa*, and *Pinus strobus* respond to root inducing chemicals with greater ease if the stock plants have been fertilized for a period before the cuttings are taken. In most cases, the cuttings rooted in periods of time approximately 70 percent shorter than work previously reported (*2,4,5, 8*). It appears that a physiological condition develops which produces a rooting response not to be had from cuttings taken from unfertilized trees.

Unfertilized cuttings rooted relatively poorly; that is usually in low percentages. Percentages of cuttings from unfertilized trees which rooted were usually markedly increased by treatment with indolebutyric acid-water dips of 20 mg/ml, 10 mg/ml, and 5 mg/ml. Indolebutyric acid and talc; 0.006 percent 2,4,5 — trichlorophenoxyacetic acid + 0.012 percent sodium salt of alphanapthaleneacetic acid; and 0.003 percent 2,4,5 — trichlorophenoxyacetic acid + 0.006 percent sodium salt of alphanaphthaleneacetic acid aided the rooting cuttings of *Picea abies*, *Pinus resinosa*, and *Pinus strobus*, but the percentages of roots stimulated by these treatments were not as great as those percentages produced by the concentrated indolebutyric acid dips.

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Photographing Forests from Helicopters

Gene Avery

HELICOPTERS OFFER distinct advantages over fixed-wing aircraft for certain types of aerial photography. Reliable photo-mensurational data may be obtained either from large-scale single prints or from stereo-pairs. This report discusses practical aspects of taking helicopter photographs and summarizes two experiments involving their use in forest inventory.

Helicopters designed specifically for taking aerial photographs are not yet in production, but the potential usefulness of rotary-winged aircraft for such work has been recognized (*3, 4*). In 1948, Short (*6*) described an outrigger bracket that could be attached to the door sill of a Sikorsky helicopter for holding a K-25 aerial camera. Single photographs of forest areas were obtained to illustrate possibilities of timber type separations on large-scale prints. During the same year, the Army's Engineer Research and Development Laboratories reported on the use of vertical stereo-pairs for obtaining precise measurements of altitude in an aerial triangulation project (*5*). Stereo-photography was made from a single air exposure station by mounting identical K-24 aerial cameras at either end of a 14-foot cross member affixed to the helicopter. In 1956, Colwell (*2*) obtained vertical and oblique stereograms of cereal crops with a hand-held aerial camera operated from separated exposure stations. Photographs were made on both black-and-white and color films to determine their usefulness in detecting plant diseases.

Helicopters exhibit the greatest degree of superiority over fixed-wing aircraft in situations where low-altitude flying is required. Ability to maintain horizontal flight at low air speeds makes them especially valuable for taking large-scale photographs of spot locations, such as scattered forest inventory plots or small plantations and cut-over areas. Sharp negatives are feasible at ordinary shutter speeds, and camera recycling time is not so critical as with faster-moving, conventional planes. The principal restriction is the high hourly cost of helicopter operation. Contract rates for helicopter and pilot commonly range from $75 to $125 per hour, though costs may be much less when agencies operate their own aircraft.

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Technical Problems

Among prominent technical difficulties peculiar to low-altitude helicopter photography are (1) limitations of weight and space for photographer and equipment, (2) aircraft vibrations, and (3) difficulty in precisely determining altitudes above ground.

With small, three-place helicopters, the load capacity is approximately 550 pounds. If 175-200 pounds each is allowed for photographer and pilot, only 150-200 pounds is left for cameras, mounts, and accessories. This is sufficient for most photographic projects, but capacity is reduced if there is a third passenger or if extra fuel tanks are added to increase flying time. Bulky equipment will not fit inside the cabin, and it is not ordinarily feasible to cut an opening in the floor to accommodate regular camera mounts. Most cameras must therefore be hand-held or attached to brackets outside the right door opening. Concentration of too much weight on one side may alter the ship's center of gravity and reduce flight performance. When helicopters cannot be structurally modified for efficient weight distribution, light camera equipment is a virtual necessity.

Aircraft vibrations are most serious when the ship is hovering or maintaining low airspeeds with a full payload of passengers, equipment, and fuel. Elimination of extra gas tanks is of some help but necessitates more frequent refueling. A better alternative is to maintain an air speed of about 20 knots on photographic runs. If interrupted stereo-pairs are being taken, it may be feasible to fly upwind for all exposures, so as to increase effective airspeed while minimizing groundspeed. Maintaining horizontal flight is also safer than taking photographs from a hovering position. If the engine fails, airspeed is of considerable assistance in reaching a clearing for an emergency "auto-rotational" landing.

Barometric altimeters are usually graduated for 20-foot differences in elevation, but indicated altitudes are not sufficiently precise for determining scales of large-scale photographs. In a recent test by the Southern Forest Experiment Station (*1*), indicated altitudes differed 5 to 40 feet from true altitudes calculated from known ground distances. Such deviations may be ignored in high-altitude photography, but are intolerable when flying heights are reduced to 200-500 feet. Unless ultra-sensitive altimeters are used, known ground distances must be available for determining scales of low-altitude photographs. Split-image range-finders, "droppable" markers, expendable lead lines, and radio altimeters have been tested, but none have proven entirely satisfactory (*2, 5*).

Single Prints for Tree Measurements

In 1947, TVA's Division of Forestry Relations made large-scale aerial photographs of several forest plots from a small Bell helicopter.[1] The right door of the aircraft was removed, and an overhanging plywood camera mount bolted to the floor. The mount supported a Folmer K-5 aerial camera that was leveled and operated by hand.

[1]Appreciation is expressed to the Division of Forestry Relations, Tennessee Valley Authority, for use of technical data cited from this experiment.

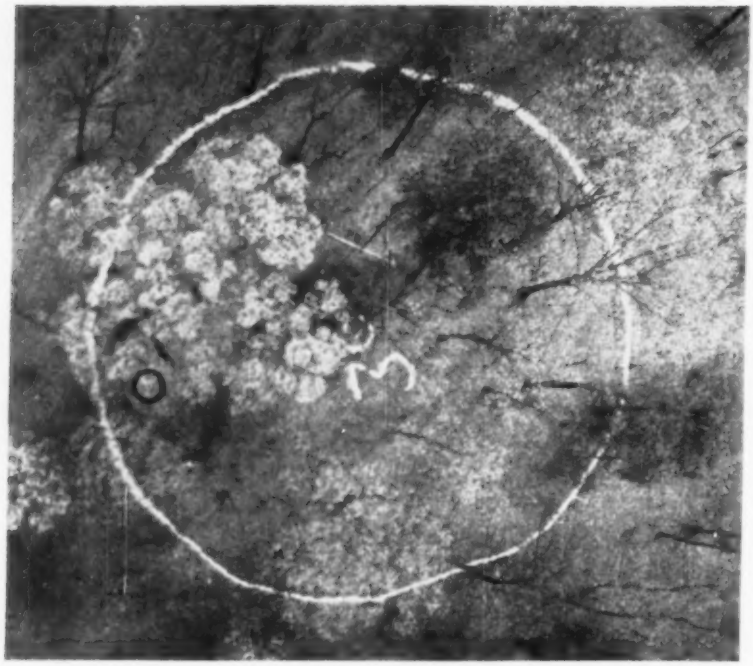

FIG. 1.—Portion of single vertical photograph of mixed pines and hardwoods taken on panchromatic film with a Folmer K-5 camera. Altitude above ground: 300 feet. Circle size: one-fifth acre. Reproduced by courtesy of Tennessee Valley Authority.

Single, non-overlapping photos were taken of six 1/5-acre circular plots. A large degree of image displacement and sparse hardwood foliage permitted direct measurement of tree stems on plot 3 (Fig. 1). D.b.h. measurements were made with a mil-scale incorporated in a 40X shop microscope; merchantable and total heights were determined with an engineer's scale.

Interpretation was restricted to trees that were most clearly defined. A comparison of photo and field measurements for 15 sample trees is given in Table 1. It can be seen that photo measures of stem diameter agreed closely with field values, the maximum deviation being 2.5 inches for tree 13. Comparisons of merchantable and total heights likewise showed small differences, although poor definition prevented some heights from being measured.

As might be expected, trees having the greatest image displacement were easiest to assess on the single prints, i.e., measurements could be made more easily and accurately for trees farthest from the nadir.[2]

To take maximum advantage of this photogrammetric characteristic, single prints could be made with cameras having wide-angle lenses to increase image displacement. Instead of using conventionally shaped plots for interpretation, measurements might logically be made on doughnut-shaped plots centered about the nadir. This would eliminate difficulties of making accurate measurements in the area immediately around the nadir, where tree crowns restrict the view of their associated stems. Crown interference can be additionally minimized by taking single photographs when deciduous species are leafless.

[2]The nadir is the point at which a vertical line through the perspective center of the camera lens pierces the plane of the photograph. It is also the focal point of topographic displacement. If the photograph is truly vertical, the nadir coincides with the easily located principal point.

Stereo-Pairs for Stand Measurements

In March 1957, the Southern Forest Experiment Station and TVA cooperated in a test of low-altitude stereo-photography taken from a Bell 47D helicopter (*1*). As the desired type of aerial camera equipment was unavailable, a mount holding two identical reflex cameras was built for taking stereograms from a single air exposure station. Cameras had a negative format of 2¼ by 2¼ inches and were 36 inches apart. Though a greater camera separation would have been desirable to increase stereoscopic parallax, the improvised mount was the maximum size that could be effectively hand-operated from a small helicopter.

Six 1/5-acre forest plots were

TABLE 1.—PAIRED PHOTO AND FIELD MEASUREMENTS FOR 15 TREES ON A SINGLE, LOW-ALTITUDE AERIAL PHOTOGRAPH

Tree	Species	Stem d.b.h.		Merch. height		Total height	
		Photo	Field[1]	Photo[2]	Field	Photo[2]	Field
		Inches		*Feet*		*Feet*	
1	Pine	13.0	12.9	61	62	81	80
2	Pine	10.8	11.9	51	53	70	71
3	White oak	10.8	11.9	55	38	86	79
4	White oak	8.6	9.7	36	36	82	77
5	White oak	12.1	14.1	57	42	86	78
6	Pine	10.0	11.1	48	47	....	66
7	Red oak	7.6	8.1	47	36	....	51
8	Red oak	10.0	10.6	53	48	89	89
9	White oak	16.4	16.8	41	40	91	81
10	White oak	17.6	18.1	52	61	99	92
11	Sourwood	5.0	4.8	21	19	46	37
12	Pine	13.9	14.6	70	65	83	75
13	White oak	10.0	12.5	55	55	....	94
14	White oak	8.8	10.0	26	27	....	58
15	Pine	15.1	16.2	....	52	93	87

[1]Measured with tree calipers.
[2]Height measurements omitted where stems were indefinable.

marked on the ground and photographed on both black-and-white and color films. Stereograms for one pine plot and one hardwood plot are shown in Figure 2. On the original print of Plot 2, shortleaf pines could be easily distinguished from loblolly pines by their needle characteristics. Separation of hardwood species was not possible, as the trees were leafless.

Photo interpretation was restricted to 200-foot and 300-foot panchromatic photographs and to 300-foot color transparencies. Scales ranged from about 1:650 to 1:1,250. Comparative measurements were also made on 1:20,000 USDA panchromatic photographs. On each set of vertical stereograms, three individuals evaluated average total height of the three tallest trees, average crown diameter of the three largest crowns, and crown closure percent of the stand.

Mean differences between photo and field measurements of the three stand variables are given in Table 2. The most evident trend from the table is that tree heights were underestimated by all interpreters on 1:20,000 photos and consistently overestimated on helicopter stereograms.

Analyses of variance indicated that the helicopter stereograms as a group were superior to 1:20,000 photos for evaluating average tree heights and crown diameters. No significant differences were noted between types of helicopter photography. Crown closure measurements were comparable for all types and scales of photography, though the color stereograms gave slightly poorer results than black-and-white prints. In short, helicopter stereograms were better for interpretation than 1:20,000 photos, but the degree of superiority was not felt to be sufficient to justify the cost of helicopter operation.

Summary and Conclusions

The studies reviewed here indicate that helicopters are well adapted to taking large-scale, low-altitude aerial photographs of forest areas. To offset flying costs, however, such photographs must be expected to yield information not obtainable from conventional 1:15,840 or 1:20,000 prints. Extensive tests are needed to determine the most suitable types of cameras and mounts for operation from rotary-winged aircraft. Even under ideal conditions, costs are likely to limit the use of helicopters to photography of relatively small or high-value stands. Expenses might be lowered by combining aerial photography with other work projects, as transporting field teams to inaccessible plots, making

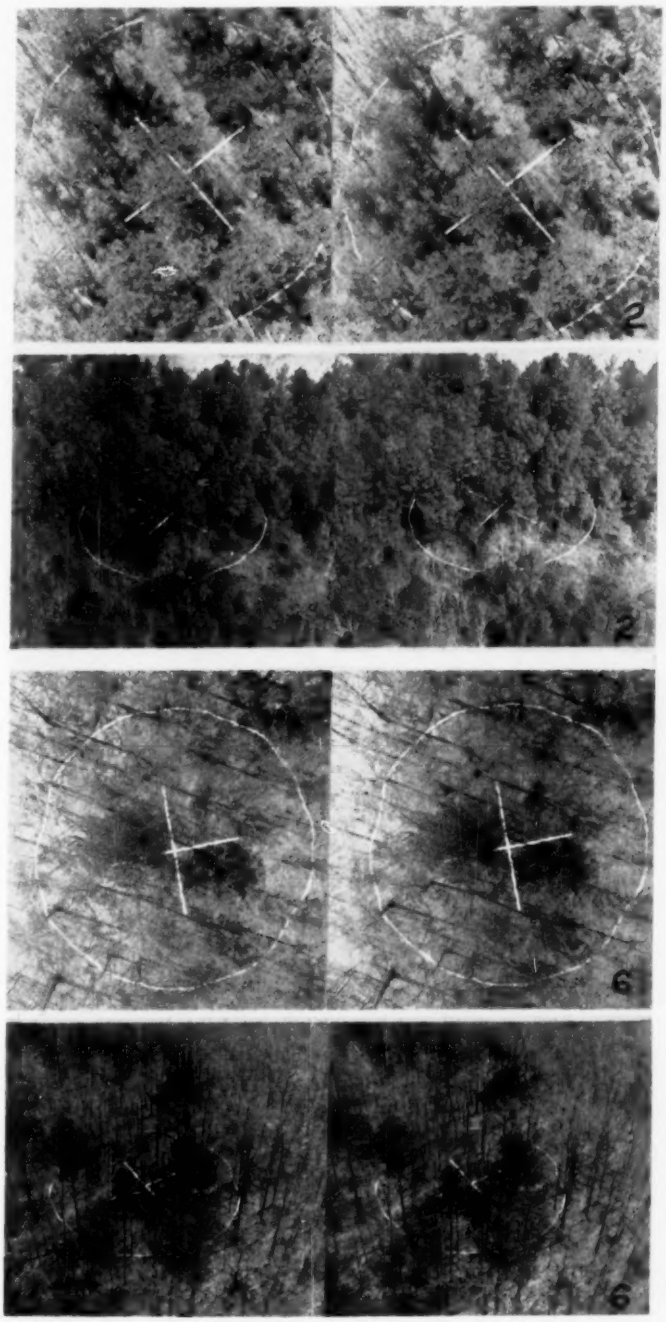

FIG. 2.—Vertical and oblique stereograms of pines (above) and hardwoods (below) taken on panchromatic film with the twin-camera mount. Altitude above ground: 200 feet. Circle size: one-fifth acre.

TABLE 2.—THREE INTERPRETATIONS OF MEAN DIFFERENCES BETWEEN PHOTO AND FIELD MEASUREMENTS ON HELICOPTER STEREOGRAMS

Type of photography	Interpreter A	Interpreter B	Interpreter C
	Total height differences in feet[1]		
1:20,000 pan	−6.8	−5.5	−13.0
300-foot pan	+1.3	+1.3	+ 8.0
200-foot pan	+2.5	+1.8	+ 1.2
300-foot color	+2.2	+4.0	+ 8.7
	Crown diameter differences in feet[2]		
1:20,000 pan	0.0	−2.2	−4.0
300-foot pan	−1.0	− .8	−1.0
200-foot pan	+ .3	+ .7	− .3
300-foot color	− .8	−1.0	−1.2
	Crown closure differences in percent[3]		
1:20,000 pan	+2.0	−6.0	−2.0
300-foot pan	+ .2	+4.4	−2.4
200-foot pan	+2.0	+3.8	−3.0
300-foot color	−2.6	+3.0	−4.2

[1]Actual mean height: 53.8 feet.
[2]Actual mean crown diameter: 19.00 feet.
[3]Actual mean crown closure: 41 percent.

forest insect surveys, or seeding cutover areas.

Where dual-camera arrangements are employed for taking stereo-pairs, cameras should be separated at least 10 to 15 feet to assure a measurable degree of stereoscopic parallax. Cameras with narrow-angle lenses must be used at low altitudes to keep image displacement within limits for comfortable stereoscopic viewing. By contrast, when single prints are relied on for direct photo measurements, wide-angle lenses are desirable to increase image displacement.

Camera vibrations can be minimized by taking photographs with the helicopter in horizontal flight, rather than from a hovering position. By flying upwind, groundspeed can often be kept under 25 m.p.h., a rate at which ordinary shutter speeds can be used. Altimeters installed in most helicopters are not sufficiently accurate for determining exact scales of low-altitude photography, and more sensitive instruments must be employed to avoid the necessity of making scale determinations from ground markers.

Color film has a limited latitude of exposure, and processing costs are high. At a given scale, it appears to have no photo-mensurational advantages over black-and-white photography. Color transparencies would seem to be of greatest utility for qualitative interpretation, as in the tonal separation of hardwood species-groups.

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Coming Events

Associated Forester Conclave

This year's Associated Forester Conclave will be held jointly at the University of Idaho and Washington State College campuses May 7, 8, and 9. In conjunction with the conclave the Associated Foresters of Idaho will celebrate their fiftieth anniversary.

Gulf States Section

Plans have been made for the annual meeting of the Gulf States Section to be held May 7-8, in Tyler, Texas.

Northern California Section

A field meeting of the Northern California Section will be held on June 5 and 6 in the Santa Cruz area.

Southern Tree Improvement Conference

The fifth Southern Tree Improvement Conference will be held June 11-12 at North Carolina State College, Raleigh.

Northeastern Forest Tree Improvement Conference

The seventh annual Northeastern Forest Tree Improvement Conference will be held at the University of Vermont, Burlington, August 18-19.

Soil Conservation Society of America

The Soil Conservation Society of America will hold its 14th annual convention August 26-29 in Rapid City, S. Dak.

Lake States Forest Tree Improvement Conference

The Fourth Lake States Forest Tree Improvement Conference has been scheduled for October 6 and 7, at the University of Michigan, Ann Arbor.

Society of American Foresters

Annual meeting—November 15-18, San Francisco, Calif.

Control Techniques for Managed Even-Aged Stands

J. J. Wiley, Jr.

FORESTERS HAVE ACCESS to a considerable fund of data derived from measurements of trees and stands. The bulk of these data are retrospective in nature and often have no utility for application to present managed stands. This is the result of their collection in unmanaged stands where growth and development of the individual trees and the stands in general are greatly different from that in the managed stands of today. Farmers and nurserymen know what are normal crop conditions at given times during crop life, but foresters have few stand goals. Published stand development data (yield tables) have been deliberately derived only from stands which have never been cut and which are considered to have grown under heavily stocked conditions throughout their lives. A general lack of stand histories leaves these as the only types of stands in which stand conditions throughout stand life have been known. Also the great variability of types of cuts applied to stands has meant that in stands where more than one cut has been made no two of the cuts may have been alike or had the same purpose.

The result of the preparation of yield tables from uncut stands is that they cannot be applied to stands under management, where they are sorely needed today. Attempts to apply the so-called normal yield data to managed stands are futile since the development of the bulk of the individual trees in an unmanaged stand is comparatively slow and the sizes shown as normal in the various categories have long been surpassed under management. Likewise, the number of trees shown by the published yield tables to be needed at a given time in a given stand is grossly out of line with the number found in managed stands where the trees are larger and require more growing space individually than most of those measured in unmanaged stands. Indeed the word normal, through its association with the measurements of unmanaged stands, has come to connote to some foresters that which is inapplicable.

Certainly, though, there are normal patterns of development for stands growing under specified conditions. For stands under management normal development is vastly different from normal development for stands which are not managed and it should not surprise us to find that published yield data do not fit managed stands. We need yield data from managed stands to indicate normal development levels for such stands. But the collection of data from managed stands over whole rotations requires long periods of time and great expense. Growing space and yield studies for stands growing at different density levels are underway by the Forest Service but conclusive results from the studies are still a long way off.

Thus the profession is without yield tables for managed stands and the need for ever more accurate projections naturally accompanies the tremendous surge of interest in forestry which now surrounds us. For this reason we have developed at Summerville over the past ten years devices which provide us with useful control over managed stands as well as a reasonable capacity to predict sizes and volume of our future stands. The devices have been applied successfully to both pines and hardwoods growing in even-aged stands from Georgia to Pennsylvania.

Full Stocking

Since there is no general agreement on the point at which full stand stocking is reached it was necessary for us to decide as a starting point what we would accept as full stocking in any even-aged stand. In other words, to what density would we allow an intermediate stand to grow before we would make a developmental cut or accept the stand at rotation age as a full crop? We wanted this point to be such that the timing of developmental cuts would maintain the growth rate of individual stems at a high level, producing at maturity a crop of trees which had grown under stand conditions (as opposed to open grown) but in which the stand members had grown to the

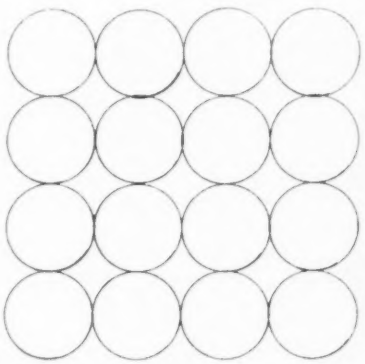

FIG. 1.—Crown canopy in a 17 year slash pine stand prior to first thinning. *Left*, shown diagrammatically; *right*, photographically.

THE AUTHOR is timber management coordinator, West Virginia Pulp & Paper Co., Summerville, South Carolina.

largest diameters the site and age conditions would permit. From observations made over the years we believed that the point of individual growth restriction is reached when the crowns touch and before any interlacing takes place. Looking upward from the floor of a regularly spaced stand of similar crowns which have reached this condition the canopy would appear diagrammatically as shown in Figure 1, *left*, and photographically as shown in Figure 1, *right*.

Decision was made to accept this canopy condition as representative of full stocking and this provided us with a handy tool for woods application. However, we wanted the condition to be not only observable but measurable by customary ground inventory techniques. How many trees of a given size would be required to stock an acre of land with crowns just touching but not interlacing? If we knew this the canopy condition would be measurable in terms of basal area which is readily obtained by ground tally.

To make this determination we made use of two additional devices. First, we put the closed canopy condition on a measurable basis. This was accomplished by superimposing on each of the diagrammed crown perimeters shown a square having the same length and width as the diameter of the crown. The use of squares was not an attempt to indicate that tree crowns are square but a recognition that in well stocked even-aged stands the canopy is never filled with crowns. Instead, the canopy is filled with crowns and openings which reach approximate full density when each tree is provided with growing space equal to the lateral area of its crown plus the areas of the four corners of its superimposed square. Having placed a square about each crown the diagram appeared as shown in Figure 2.

There are 43,560 square feet of air space above each acre of land. When the sum of the superimposed squares equals 43,560 square feet an acre of forest will be represented. Or to put it another way the square of the diameter of the average crown indicates the growing space need of the tree of average size. By dividing this figure into 43,560 square feet of air space per acre the number of trees which will occupy this acre in a full stocked stand can be determined.

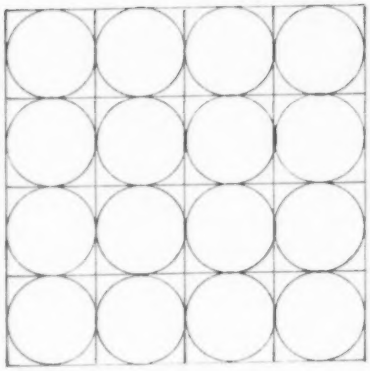

FIG. 2.—Crown canopy diagram in Figure 1 shown with superimposed squares.

At this point the number of trees per acre in a managed stand is measurable if crown diameters are known. But the usual forest inventory takes measurements from tree stems, not crowns. If a relationship could be found and measured between crown diameter in feet and d.b.h. in inches, the full stocked condition could be measured in terms of numbers of trees of various sizes per acre or basal area. This was the second device employed.

Observations of trees growing in the woods had indicated that direct and measureable relationship between crown width and stem d.b.h. does exist, so measurements were made to learn the relationship. For all species studied the relationship is straight line until large d.b.h.'s are reached, and it is not affected by site or stand density. In other words, large trees have wide crowns and small trees have narrow crowns wherever they grow and under whatever conditions. A typical crown diameter-stem diameter curve is shown in Figure 3.

Having developed the crown-stem relationship the closed canopy condition could now be measured in terms of basal area. For any given d.b.h. the average crown diameter is read from the curve. This figure is squared and the result divided into 43,560 to determine the number of trees per acre fully stocked. The basal area for a tree of this size is then determined and multiplied by the number of trees per acre required for full stocking. In this way the basal area per fully stocked acre is determined. For loblolly pine basal areas computed at close to 130 square feet per fully stocked acre for all d.b.h.'s.

Early measurements of the Forest Service growing space plots indicate that poor sites will not support this much basal area and produce maximum net growth. In other words, on these sites trees need more growing space than is provided by this technique. The degree of density reduction needed for optimum growth conditions is not known but when it is available these data can be adjusted and the balance of the technique developed from that base.

Plantation Spacing

Knowledge of the crown-stem relationship provides the forester with a useful tool for determining plantation spacing. Many plantations have been established on a guesswork distribution basis and all too often the result is an over stocked advanced plantation composed of trees too small for utilization but which are growing extremely slowly in diameter because of the severe competition. If the crown-stem relationship is known, however, the plantation can be set out on a spacing which allows rapid individual development to the point of merchantability. At that time the owner can conduct a merchantable thinning in contrast to facing the prospect of a pre-commercial thinning at cost or a long wait for the trees to reach a merchantable size. For example if the smallest merchantable diameter is 6 inches and the crown-stem curve shows that 6-inch trees have 8-foot crowns, an 8x8-foot spacing will provide a plantation which will make good individual growth until the canopy closes at which time a commercial thinning can be made. Planting at a closer spacing would waste trees and planting effort and cost as well as insuring

that either a pre-commercial thinning would be needed or a much longer wait for initial thinning income would be encountered.

Yield Tables for Managed Stands

With the technique for determining number of trees required per fully stocked acre now developed, information from one additional field would allow the preparation of yield tables for managed stands. If we knew the sizes of trees in managed stands at various ages and on various sites we could prepare managed yield tables.

We do not know from stand measurements just what sizes are reached by trees in managed stands but we do know that thinning and stand improvement work tend to remove from stands the smaller, poorly formed trees, leaving a residual of dominant and codominant trees (Fig. 4). As the number of developmental cuts made in a given stand increases this trend becomes more conspicuous. We therefore concluded that our managed stands will be composed of trees of the same sizes as the dominants and codominants we now measure to determine site index.

Because we map our sites with care and record the measurements of trees used for site class determination (with d.b.h. added) we have a fund of thousands of measurements taken from trees of all species on all sites and at all ages. Classification of these data by species, site classes, and age classes provided us with ample information on average sizes and size ranges obtained by dominant and codominant trees. Using average d.b.h.'s and heights on the various sites and at the various ages supplemented by crown width data secured from the crown-stem curves we prepared tables showing numbers of trees required in fully stocked managed stands. Volumes were applied from standard volume tables. Board foot and cord separations were based on the range of d.b.h.'s shown in the various classifications. A typical cords-all-trees table for loblolly pine is shown in Table 1.

Thinnings

Preparation of the yield tables for managed stands provides a ready-made guide and control for thinning type and intensity. Our experience at Summerville is that markers tend to spend an unwarranted portion of their time examining trees to cut—certainly their attention is divided between trees to cut and trees to leave by most marking techniques. Since the trees to be cut are to be removed anyhow there is no particular reason from a stand conditioning standpoint for spending time on them. The purpose of thinning is to select the best possible residual trees having the optimum distribution and spacing. Markers can best accomplish this objective by ignoring the cut trees while marking and turning their full attention to the stand to be left which is usually composed of dominant and codominant trees. If the desired average spacing of the residual trees is known a very uniform stand can be left in excellent shape for maximum growth

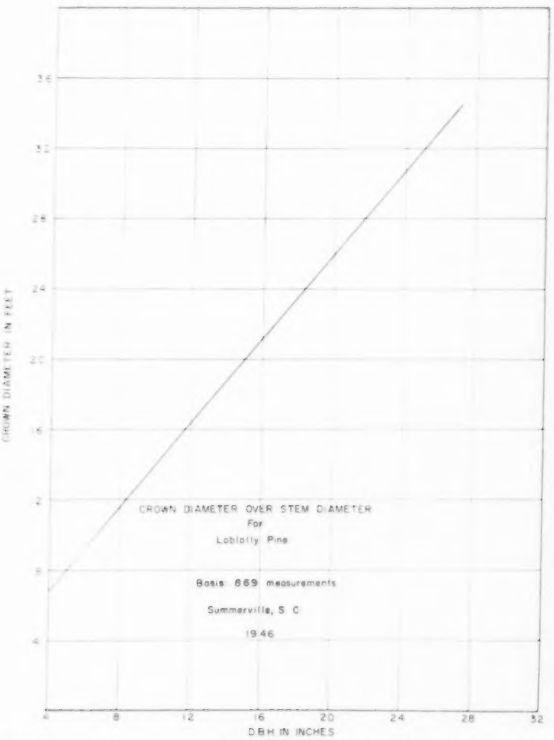

FIG. 3.—Typical crown diameter-stem diameter relationship.

FIG. 4.—Residual stand following thinning and stand improvement.

TABLE 1.—PORTION OF A YIELD TABLE FOR FULLY STOCKED LOBLOLLY STANDS UNDER MANAGEMENT

Site	Age	No. trees	D.b.h.	Total height	Crown diameter	Crown diameter²	Trees per acre	Cords per tree	Cords per acre	Basal area per acre
70	20	6	8.8	40	12.4	153.8	283	.0591	16.7	119.4
	30	48	11.0	53	15.1	228.0	191	.1312	25.1	126.1
	40	80	12.5	63	16.9	285.6	152	.2067	31.4	129.5
	50	92	13.6	70	18.2	331.2	132	.2756	36.4	133.2
	60	42	14.5	74	19.2	368.6	118	.3347	39.5	135.3
	70	11	15.2	77	20.0	400.0	109	.3905	42.6	137.3
	80		15.8	79	20.8	432.6	101	.4364	44.1	137.6
80	20	16	9.4	45	13.2	174.2	250	.0788	19.7	120.5
	30	99	11.7	60	16.0	256.0	170	.1706	29.0	127.0
	40	101	13.3	73	17.8	316.8	137	.2789	38.2	132.2
	50	89	14.5	80	19.2	368.6	118	.3642	43.0	135.3
	60	45	15.4	85	20.3	412.1	106	.4430	46.9	137.2
	70	12	16.2	89	21.2	449.4	97	.5152	50.0	138.8
	80		16.9	91	22.1	488.4	89	.5742	51.1	138.7
90	20	30	9.8	52	13.6	185.0	235	.0984	23.1	123.1
	30	98	12.3	67	16.7	278.9	156	.2133	33.3	128.7
	40	77	13.9	80	18.5	342.2	127	.3281	41.7	133.8
	50	48	15.2	90	20.1	404.0	108	.4594	49.6	136.1
	60		16.2	97	21.2	449.4	97	.5709	55.4	138.8
	70		17.0	101	22.2	492.8	88	.6628	58.3	138.7
	80		17.8	103	23.2	538.2	81	.7547	61.1	140.0

Board feet—cord breakdown can be made on basis of d.b.h. distribution by classifications.

attainment during the thinning interval (Fig. 4). Leave marking is most efficient and economical but cut marking is sometimes required by conditions. Either type of marking can be readily employed.

Information on correct spacing of the residual can be quickly and easily secured from the yield tables for managed stands. If the thinning interval is ten years, the stand should be cut back now to the number of trees needed for full stocking ten years hence (Table 1). For a twenty year stand on an 80-foot site this number of trees is 170, shown under the 30 year age data. Correct average spacing for this number of trees is also shown to be 16 feet in the 30 year age column under "crown diameter." Using this average figure as a guide for spacing of the residual stems, the marker can move laterally back and forth through the stand, keeping his marks before him and leaving the best distributed stand composed of the best trees available. Variations in density within the stand are smoothed out and improved by this method. The exercise of sound judgment by the marker can prevent the technique from becoming mechanical as there is ample opportunity for him to choose the best trees while using the average spacing figure within a reasonable but narrow plus and minus range. The resulting stand will be in condition to grow at a maximum rate to another closed canopy ten years hence when it will again be ready for thinning.

When thinnings are made in young stands which have never before been thinned, it is often found necessary to mark for retention some trees having a lower crown classification than codominant. This is the result of the requirement for leaving a relatively large number of trees at a relatively close and uniform spacing. These trees are smaller in diameter and crown size than the dominants and codominants on which the yield data were based. Where the necessity for retaining some of them occurs, the leave stand does not occupy the site as fully as planned and correction of the spacing guide is needed. A simple adjustment can be made by tallying in a marked stand the retained diameters (which will average smaller than those for dominants and codominants) and recalculating the required leave stand on the basis of the smaller average diameter obtained.

Discussion

How much growing space do individual trees need? Perhaps some day far in the future we will learn the answers from present and prospective studies. In the meantime the technique described provides quick and easy answers which are entirely adequate for control purposes. Certainly other factors beside lateral crown growth affect stem development but none is readily observed or measured. And all foresters look to the canopy for silvicultural guidance.

When is a given stand fully stocked? Perhaps some day in the future we will have the answer to this, too, from a stand performance measurement basis. But stands which have been under management for a long time are few, and young stands now growing under management for the first time will be a long while in producing development figures for a rotation. In the meantime, take any forester into the woods and ask him whether or not a given stand is fully stocked. His eyes will move at once to the canopy to see whether or not it is closed. And what more logical way is there for making this determination?

To what sizes will trees develop under management? The eye of any practicing forester is caught by the artificial look of a stand which has undergone management with its cleaning, weeding, stand improvement, and thinning cuts. What the eye sees is a stand which has been gradually reduced in numbers of trees per acre over the years, with the best trees surviving. Inevitably the stand comes after a series of

cuts to be composed of trees all of which were originally counted among the dominants or codominants. Often the first thinning brings it close to this condition. If our projections of sizes and volumes for managed stands are based on the development made over the years by our dominants and codominants, how can we expect the members of our managed stands to produce more? Of course, we hope to grow bigger and better trees through genetics but this is another long time proposition. And we hope to improve our site qualities through controlled drainage. But these are potential improvements which we cannot measure today nor can we wait for them to arrive. We have to work now with the stands we have now.

Ten years' use of these techniques have brought us an excellent degree of control over our even-aged stands. Perhaps other foresters will also find them useful.

Color, Form, and Growth Variations in Eastern Redcedar

Leon S. Minckler
and Russell A. Ryker

CERTAIN characteristics of eastern redcedar (*Juniperus virginiana* L.) differ inherently according to location of seed source. Such things as survival, winter-foliage color, form, and growth rate are among those characteristics found to be affected. Since such characteristics often determine the use to which redcedar will be put—whether for posts, specialty lumber, or Christmas trees—it is important to know what these variations are and where to find seed that will produce the desired tree characteristics.

As a first step, 2-year-old seedlings from eight geographic sources of eastern redcedar seed were planted in 1951 in old fields of southern Illinois. The variations that occurred are reported here.

Methods of Study

Redcedar seed was supplied by several public forestry agencies. Seed lots were mixtures collected from several to many individual trees in a given area. Six of the seed lots were identified by county; in two cases only the state was known (Table 1). As it turned out the best seed source was a group of 6 trees that can be identified.

The seedlings were grown in one nursery bed at the Mason Nursery of the State of Illinois. The 2-year-old seedlings were field planted in randomized plots within replicated blocks on the Kaskaskia Experimental Forest. From 100 to 400 trees were planted in each plot depending upon the number of seedlings available. The planting sites were broomsedge fields abandoned 15 to 20 years ago and typical of old field sites in southern Illinois.

Inherent Variations Observed

After 6 years, variations among trees from the different sources occurred in survival, height, crown form, crown size, color of winter foliage, leaf form, and abundance of galls on foliage. The tree characteristics of a given seed source were remarkably constant from plot to plot. For example, progeny of the North Carolina coastal seed source survived very poorly wherever planted; on all plots, the Nebraska source trees were slender with purplish winter foliage; on all plots the Wilson County, Tennessee, source trees were large, broadly conical, and green; and on all plots the local Illinois trees had the fewest galls.

Progeny of the central Tennessee source were generally superior to all others; they had excellent survival and height growth, were one of the most broadly conical, and had the greatest crown volume and best color (Table 1 and Fig. 1-A). The Illinois source also had excellent survival and was broadly conical, but was shorter and had much less crown volume. Virginia source trees had good survival and height but had less crown volume. Trees from other sources were so much shorter, more slender, and less massive that they looked like younger trees (Fig. 1-B).

Survival, crown form, and tree size.—With the exception of progeny from the southeastern North

TABLE 1.—CHARACTERISTICS OF PROGENY FROM EIGHT REDCEDAR SEED SOURCES 6 YEARS AFTER PLANTING

Seed source	Average survival	Total height divided by crown diameter	Average size of tree: Total height	Average size of tree: Crown[2] volume
	Percent	*Ratio*	*Feet*	*Cubic feet*
Wilson Co., central Tennessee	92	3.1	6.0	5.9
Jackson Co., southwestern Illinois	97	3.1	4.9	3.2
Anderson Co., eastern Tennessee	45	3.4	5.2	3.2
Albemarle Co., north-central Virginia[1]	91	3.6	6.2	4.8
Woodward Co., northwestern Oklahoma	90	3.7	4.2	1.4
Brunswick Co., southeastern North Carolina	16	3.8	3.9	1.1
Nebraska	84	3.9	5.6	3.0
Wisconsin[1]	96	4.1	5.0	1.9

[1]Fire destroyed all except one plot replication. Other sources have 3 or 4 replications.
[2]Assuming a conical shape. Volume cone = 1.047 r^2h.

THE AUTHORS are foresters, Carbondale (Illinois) Forest Research Center, Central States Forest Expt. Sta., Forest Service, U. S. Dept. Agric.

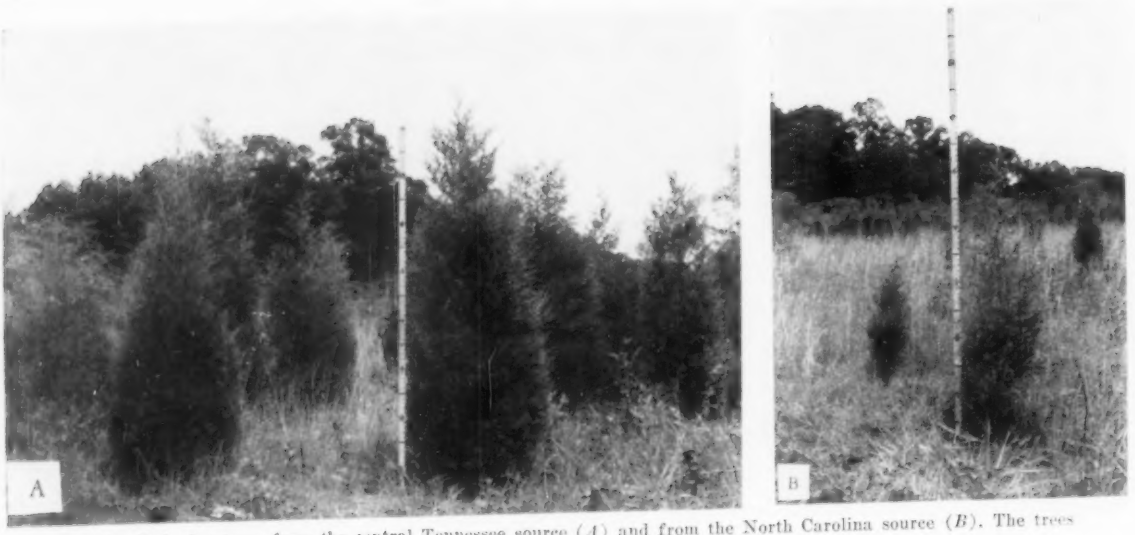

FIG. 1.—Redcedar trees from the central Tennessee source (*A*) and from the North Carolina source (*B*). The trees are midway in the 8th growing season. The pole is 8 feet tall.

Carolina and eastern Tennessee sources, survival was excellent (Table 1). The crown form among the sources varied from "bushy" (broadly conical) to slender (almost cylindrical). The trees from central Tennessee and Illinois sources tended to be most broadly conical with tree-height/crown diameter ratios of 3.1 to 1 (Table 1). Trees from the other sources were more slender, especially those from North Carolina, Nebraska, and Wisconsin. Differences among these tree-height/crown-diameter ratios suggest classifying the 8 seed sources into 4 groups, as follows:

Seed sources	Crown form
Central Tennessee and Illinois	Very broadly conical
Eastern Tennessee	Broadly conical
Virginia, Oklahoma, North Carolina, & Nebraska	Slender, conical or cylindrical
Wisconsin	Very slender or cylindrical

Among the above groups differences in the crown form ratios are statistically significant.

Average crown volume and total height varied greatly among sources. Average crown volume ranged from 1.1 to 5.9 cubic feet and average total height from 3.9 to 6.2 feet (Table 1). The largest trees (central Tennessee) were more than 2 feet taller and had 5 times more crown volume than the smallest (North Carolina) (Fig. 1). Based on crown volume, the sources fall into 3 groups:

Central Tennessee & Virginia	5.4
Illinois, eastern Tennessee, and Nebraska	3.1
Oklahoma, North Carolina, and Wisconsin	1.5

The statistical differences among these groups are highly significant.

Color of winter foliage.—Foliage color on March 4, 1957, showed marked differences among sources. By April 2, winter color had disappeared and all foliage was green. During the winter there were minor color differences among trees of the same source, but generally all of the trees from each source were very similar. A description of foliage color of all sources is given below:

Seed source	Winter foliage color
Central Tennessee	Green with some trees slightly tinged with brown
Virginia	Green and most trees tinged with brown
Oklahoma	Green and most trees tinged with brown or purple
North Carolina	Light pale green with brownish patches on most trees
Eastern Tennessee	Greenish brown, a few green trees
Illinois	Brown or greenish brown, very few green trees
Nebraska	Purple or purplish, no green trees
Wisconsin	Reddish or purplish brown, some trees a dead brown, no green trees

Leaf form and cedar-apple rust.—Redcedar winter foliage normally has two leaf forms: The appressed scale-like leaves and the sharp-pointed, awl-shaped leaves. The latter usually occur toward the bottom of the crown. Trees of both the Illinois and the central Tennessee source had appressed leaves over the whole crown or only a narrow zone of sharp-pointed leaves near the base. Trees from the North Carolina and the Nebraska sources, however, had the sharp-pointed leaves on half or more of the crown area. The other sources, eastern Tennessee, Oklahoma, Wisconsin, and Virginia, had intermediate distribution of the two leaf types. These differences in leaf form tended to persist in the summer foliage.

Galls of cedar-apple rust (Gymnosporangium) were present on trees from all sources, but the local Illinois seed source showed the greatest resistance to the disease. The central Tennessee source was moderately susceptible and trees from eastern Tennessee, Oklahoma, Virginia, and Nebraska had many old galls when examined in February.

Significance of Results

The consistency and magnitude of the observed variations obtained in this study are good evidence that the variations observed are genetic. There were wide inherent variations among the 8 sources in at least 6 characteristics. It should not be inferred, however, that these variations are necessarily typical of the different geographic locations represented in this study. They are typical only insofar as the samples are representative. Nevertheless, the results illustrate the importance of seed source selections in tree planting projects.

Knowledge of these inherent differences could be used in several ways. The highest yields of specialty lumber could be produced from the fastest growing trees with good survival. The same is true for fence posts. Varieties with purple winter foliage or cylindrical crown form may have ornamental value. Trees with sharp-pointed leaves might be used for protective hedges while trees with scale-like leaves could be used in hedges where beauty and lack of prickly leaves are more important.

Another important and profitable use of redcedar is for Christmas trees. It is one of the suitable species that can be grown for this purpose on old fields in the Central States. How do these different seed sources rate for Christmas tree production? Several sources can be eliminated at once. Trees from seed sources in North Carolina, Wisconsin, and Oklahoma had low survival or were too small 6 years after planting. Trees from the Nebraska source were too slender and all of them were purple or purplish. The eastern Tennessee trees had low survival and were too brown in color. The remaining 3 sources, central Tennessee, Virginia, and Illinois, offer promise but the central Tennessee source was outstanding. Trees from the Virginia source were large enough but they were less green, more slender, and had more galls and sharp needles. Trees from the local Illinois source were smaller than those from central Tennessee or Virginia but the chief drawback for Christmas trees was the brownish winter foliage.

The central Tennessee seed was collected from 6 large trees on the Lebanon Forest of the Tennessee Department of Conservation. Seed was collected by the ranger of Lebanon Forest, from trees across the road from his residence. He stated that these trees appeared to be no different from others in the Lebanon area and further stated his belief that the redcedar of that general area was a superior strain.

This brings up a point that should be considered in all seed source tests. To detect overall genetic differences between widely separated populations (or races) of a species a representative sample of that population or race is needed. This is useful for observing characteristics such as hardiness or other genetic variations developed under *climatic* influences. Other characteristics may vary from tree to tree within a population. These would have to be evaluated by progeny tests of individual trees. Because of the relative uniformity within plots, the evidence is strong in the present study that color, crown form, resistance to galls, and leaf form are population characteristics. Growth rate may be either a population or individual tree characteristic or both. Future studies should include progeny tests of superior individual trees.

Summary

Eastern redcedar seed from eight widely separated sources was planted in one nursery bed and transplanted in replicated plots in southern Illinois. Six years after planting the trees exhibited wide genetic variations among the different sources. Color of winter foliage, crown form, and growth rate varied significantly among the progeny of the different seed sources. Other significant variations were survival, leaf form, and resistance to cedar-apple rust.

Color ranged from green through brown to purple. Crown form ranged from almost cylindrical to broadly conical. The range of average crown volume among sources was from 1.1 to 5.9 cubic feet. Average survival ranged from 16 to 97 percent. Leaf form varied from almost all appressed scale-like to half or more of sharp-pointed leaves. The local source had the fewest cedar-apple galls.

The outstanding progeny grew from seed collected from 6 large trees on the Lebanon Forest, Tennessee Department of Conservation, Wilson County, in north-central Tennessee. Progeny from this seed were the largest and the greenest in winter. Survival was 92 percent after 6 years. The crowns were broadly conical with mostly scale-like leaves. The high vigor and the generally good characteristics for Christmas trees, lumber, and posts make this seed source the best of those tested.

An Effective Poison and Repellent for Porcupine Control[1]

Wendell E. Dodge

THE FOLLOWING ACCOUNT is a preliminary report of experiments for the control of porcupines which have been in progress at the Massachusetts Cooperative Wildlife Research Unit since the fall of 1955. The program was supported financially by Rodent Control Funds of the United States Fish and Wildlife Service Branch of Predator and Rodent Control.

Prior to this research, Horn (*4*), Gabrielson (*2*), Hamlet (*3*), Spencer (*6*), Spencer and Hamlet (*7*) and Merrill (*5*) were the only investigators who tested chemicals as a possible means of control for porcupine. The earlier studies dealt with a strychnine-salt combination mixed in the ratio of one part strychnine to twelve parts salt. This method did not prove successful in the Northeast, which may be due to a higher consumption of tannin by the animals. Tannin is a known antidote for poisoning by strychnine. Merrill (*5*) experimented with such chemicals as micro-arsenious acid, arsenic trioxide, thallium phosphate and 1080 (sodium fluroacetate) but without much success. Many of the baiting methods were laborious and the poisons mentioned involve too many operational hazards.

Numerous factors have to be considered in the selection of any one poison for use as a rodenticide. Such variables as toxicity, dosage levels and their relative effectiveness are important. Also, tolerance development, acceptance by the animal, odor, taste and the hazard to other forms of wildlife must be considered. Operational hazards are of extreme importance.

Not all animals react alike. Some individuals are highly resistant to certain poisons while others succumb to relatively small doses. All these reaction differences have a correlation with age, sex, diet, and health of the individual. A poison candidate must fit many requirements and then that dosage which is lethal to 50 percent of the test individuals (LD_{50}) must be established. The LD_{50} is that figure from which actual poison baits are formulated.

Experiments during this study were concerned with such poisons as Aldrin, Endrin, Dieldrin, thiosemicarbazide, and sodium arsenite. Of these materials, sodium arsenite (technical), in a powder form, appeared to be the most promising as its LD_{50} for porcupines is very low in contrast to that for deer and other mammals. Also, it is readily accepted by porcupine and their resistance level is low when compared to the other poisons mentioned above (Fig. 2). The powder is easily obtainable and is relatively inexpensive.

Many baits and different combinations were investigated, but apples, containing the field dosage of 75 to 300 milligrams of technical sodium arsenite, proved to be the best. The apples are loaded by punching two to three holes of ¼-inch diameter towards the core. After the poison is inserted, the holes are sealed by squeezing the surface together. Some operators cut a wedge or cone-shaped hole in the apple for easier loading. These holes are sealed in the same manner.

Almost any apple will be accepted by the porcupine, but of the numerous varieties tested, Baldwins or Red Delicious are preferred and resist weathering better than other varieties.

The operator should avoid careless spilling of the powder and be

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[1]Contribution of the Massachusetts Cooperative Wildlife Research Unit supported jointly by the U. S. Fish and Wildlife Service, the Massachusetts Division of Fisheries and Game, the University of Massachusetts and the Wildlife Management Institute.

FIG. 1.—Defoliation of hemlocks by porcupines, a common occurrence in New England.

especially cautious when cuts or abrasions on the hands are present. Although the material is not readily absorbed dermally, it is dangerous to exposed sub-cutaneous tissues and one should observe extreme care in washing after handling the material. Rubber gloves should be an important item of the required equipment.

The best period for poisoning operations in the Northeast is during the winter months when the animals are concentrated in rock ledge denning sites and necessarily gregarious due to the scarcity of good denning sites. During the remaining months of the year, porcupines are scattered throughout the woodlands. Also, the winter months are usually a period of minimum management activities and more time can be devoted to a poisoning program.

Hazard to other forms of wildlife is minimized by placing the poisoned apples well back in the dens which are inaccessible to many animals and rarely frequented by others. The hazard is also reduced because of the higher resistance of other species to the poison and one's care in placing the baits. Secondary poisoning of carrion eaters is negligible as the porcupines die in the dens and thus are not readily available. If the poisoned porcupines are eaten, the higher resistance of the consuming animals to the poison will usually avoid fatalities. During this study, only one animal was found dead outside the den and no convulsive animals were seen at any time.

An ample number of poisoned apples should be placed to take care of the estimated denning population. The population can be roughly estimated by the appearance of droppings and trails leaving the area. Working on fresh snow is desirable as individual tracks can be more readily determined. The investigator always placed a minimum of two poisoned apples to each den and more determined by the estimated population. One application is devastating, but a second baiting should be made to insure poisoning the "wanderers" or those animals that spend a number of successive days away from the den site.

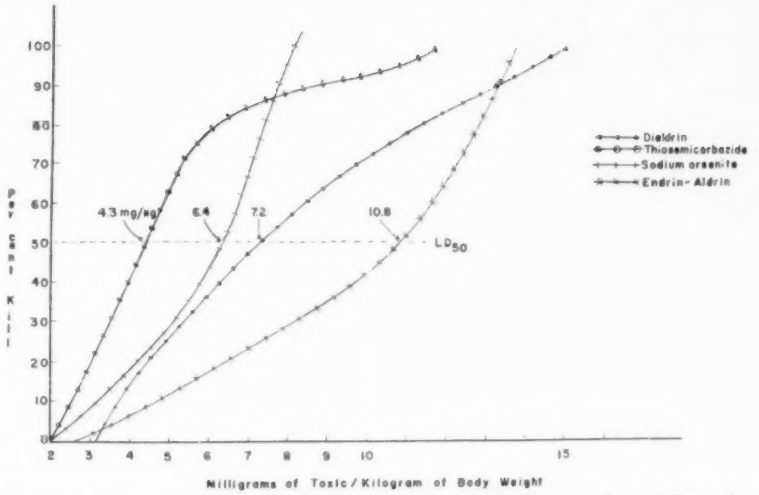

Fig. 2.—Dosage—mortality curves for acute oral toxicity of various poisons to porcupines.

During the winter of 1957 and 1958, the Vermont State Department of Forests and Parks carried out a control program using the above methods (1). A stock formulation was made by thoroughly mixing thirty-nine grams of granulated sugar with fifteen grams of technical sodium arsenite. Number 0 gelatin capsules were used which, when filled with the stock, contained approximately 150 milligrams of sodium arsenite. A suitable number of apples and capsules were given each field man and he, at the den site, applied the poison by cutting ¾-inch cone-shaped plugs out of the apple and then dusted ½ capsule to each of two to four holes depending on the size of the apple. The plugs were then replaced and the apples deposited in the den.

The program was highly selective, and of the 101,000 acres of forested land treated, 100 percent control was obtained on approximately 24,000 acres with 80 to 100 percent control on the remaining 77,000 acres. The smaller area was rechecked and rebaited, probably accounting for the higher control figure.

Concurrent with the toxicological investigations referred to above,

Table 1.—Listing of Repellent Compounds Tested and Properties

Compound	Color	State	Odor, etc.	Repellency to porcupines
TNBA	Dk Brown	Liquid	Irritating odor	None
ZAC	White	Powder	Pungent	None
TN-2500	Pink	Liquid	Pungent	None
Arasan SF-X	Pink	Liquid	Pungent	None
VC-3-100	Brown	Liquid	Irritating	High initial
DR-4077[1]	Yellow	Granular	Irritating	High 88%
DR-4073	White	Powder		None to 18%
DR-4041	Brown	Powder	Sweetish odor	None to 15%
DR-4082	Black	Solid	Pungent, Gas	None to 25%
DR-5199	Gray	Liquid	Putresent	None to 12%
H-101	Dk Brown	Solid	Pungent	None to 30%
DR-1622	White	Powder		None to 17%
DR-1919	Brown	Crystals	Sweetish odor	None
TN-2531	Yellow	Powder		None
DR-4076	White	Powder		None
DR-2610	Opaque	Crystals	Pungent	None
TMTM	Gray	Pellets	Sour	None
"Cuprinol"	Clear	Liquid	Pungent, tacky	None to 10%
CEFRO	Brown	Powder	Sweetish	None to 35%

[1]Beta nitrostyrene mentioned in text. The DR numbers are those assigned to the material by the Denver Wildlife Laboratories of the Fish and Wildlife Service.

the Research Unit carried on an extensive study to find a suitable porcupine repellent. There are numerous "Yankee inventions" for repelling porcupines such as creosote, diesel oil, used crankcase oil, peppered paint, and the placing of salt blocks some distance away from buildings, none of which is significantly effective.

All the well known repellents which have proved successful in repelling deer and rabbits were tested (Table 1). Porcupines apparently lack the gustatory acuteness of those mammals, and these materials offered no protection against its depredations.

Beta nitrostyrene, prepared from benzaldehyde and nitromethane and patented by DuPont (U. S. Patent 2,335,384, Nov. 30, 1943), mixed in a 20 to 25 percent concentration with 10 percent Altox 4500 as the emulsifying agent and Geon 145 × 3 latex adhesive[2] has given 75 to 90 percent protection in all tests. The material is easily applied by painting or spraying, and it weathers well. Because of its highly irritating characteristics, care should be taken to avoid contacts with the skin, eyes and respiratory organs. This mixture has not been tested for its phytotoxicity, and it is not recommended that it be applied to plants of any sort until such tests have been made. It is suitable for such uses as protecting cottages, boats, outdoor latrines, and similar localized applications on inanimate objects, but because of the cost factor, it is not economically feasible to make broadcast applications on a large scale basis.

[2]Altox 4500 is a product of the Atlas Powder Company and the Geon 145 X 3 a product of the B. F. Goodrich Company.

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Roy A. Phillips (1889-1959)

Mr. Roy A. Phillips, a retired veteran forester with more than 40 years' service in the U. S. Forest Service, died at Glendale, Ariz., on January 20. He was 69.

Mr. Phillips was born at Castle, Mont., on August 11, 1889. He attended Montana State University at Bozeman and also took classes in forestry at the University of Montana.

His Forest Service career began as a fire guard on the Lolo Forest in 1909. In 1910 he participated in the terrific struggle against the holocaust which swept northern Idaho and the St. Regis drainage in western Montana. Entrapped with his crew near Sildex, he held his men on a small flat and brought them through unharmed after a night of fighting spot fires which threatened to envelop their haven.

Mr. Phillips participated in early planting jobs and made important contributions to the development of Savenac Nursery. The latter was one of the pioneer forest tree nurseries in the United States. After service with the Marines during World War I, Mr. Phillips returned to the Forest Service, first on the Lolo and then on the Kaniksu Forest as assistant supervisor. In 1924 he was assigned to the St. Joe as forest supervisor. Except for two short assignments to the Regional Office Division of Operations and service on the Guayule Project during World War II, all Mr. Phillips' service from 1924 until retirement on January 1, 1952, was as supervisor of the St. Joe, Nezperce, Kaniksu, and Custer Forests.

One of his major professional accomplishments was in the field of forest road development. He became a member of the Society of American Foresters in 1921.

Zoning for the Management of Black Cherry on the Allegheny Plateau

A. F. Hough

FORESTERS USE THE term "zone" to define some specific area or condition such as a trail, waterfront, roadside, buffer strip, cambial area, or grazing dependency. The biogeographer defines "life zone" as an area dominated by particular forms of plant or animal life. In general terms, a zone is an area set off or characterized as distinct from other areas because of its use or natural characteristics.

The zoning proposed here is the separation of forest land into distinct strata or areas that differ in management possibilities for the successful perpetuation of black cherry (*Prunus serotina* Ehrh.) on the northern Allegheny Plateau. Such zoning is based principally on the critical elevation above which severe glaze-storm damage to black cherry, especially to saplings and small poles, is apt to cause serious economic losses and block regeneration efforts. Forest types at lower elevations known to be adverse for black cherry management are described and can be delineated.

The aim of zoning is to aid the forest manager in selecting the more promising areas for perpetuation of this valuable hardwood within the Allegheny Plateau of Pennsylvania and New York and in concentrating his initial efforts on such areas.

The Plateau and Its Forests

The Allegheny Plateau covers about 26 million acres (40,625 square miles) of western Pennsylvania and southwestern New York (Fig. 1). This uplifted and dissected plateau ranges in elevation from less than 1,000 feet in the valley bottoms to about 2,600 feet where the strata were domed upward in Potter County, Pennsylvania, and in parts of southwestern New York. It also includes the highest point in Pennsylvania, Mt. Davis—3,213 feet above sea-level—in Somerset County near the Maryland line.

Valleys in the nonglaciated portions of the Plateau are steep-sided and V-shaped, while interstream areas are fairly wide where held up by hard sandstone or conglomerate rock formations. Part of the plateau area has been subjected to glacial action that widened valleys and formed the Finger Lakes of New York (Fig. 1).

The climate is generally cool and moist. Much of the precipitation occurs as snow. At higher elevations, glaze or ice storms are fairly frequent during the winter months. Such storms bend and damage young black cherry growth and thus are important factors in zoning forest land for production of this species.

Originally, forest associations on the Allegheny Plateau were hemlock-beech-maple, white pine-hemlock-hardwoods, and the mixed oak-chestnut types (*19*). Logging, fire, and hardwood competition have reduced hemlock and white pine to mere remnants, and chestnut has been removed by the chestnut blight. Old- or second-growth stands dominated by white pine or hemlock are rare; and conversion of such coniferous types to black cherry is not recommended.

Present-day second-growth forests are secondary successions that have replaced the original types. Least productive are the aspen-pin cherry stages covering areas of

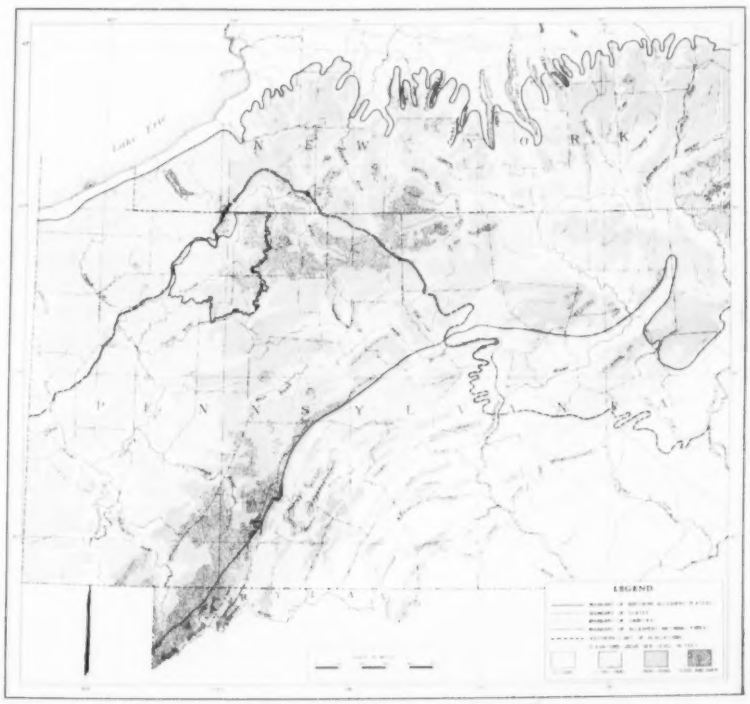

FIG. 1.—The Allegheny Plateau of Pennsylvania and New York.

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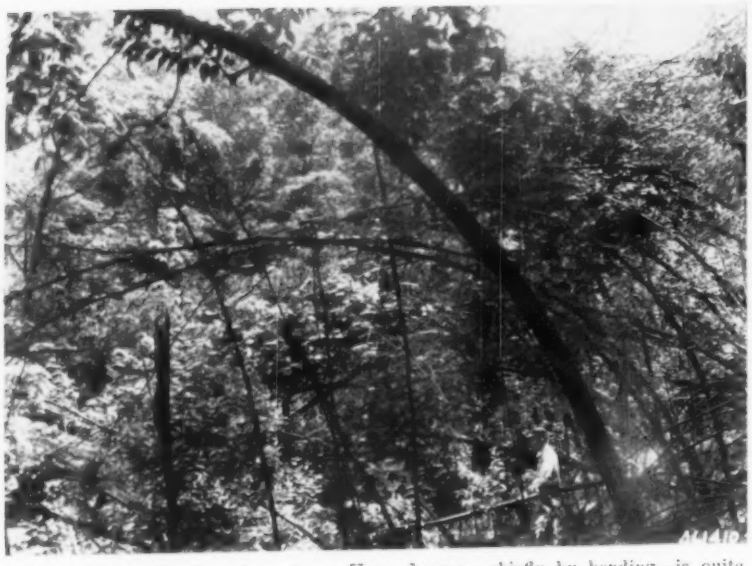

FIG. 2.—Aftermath of a glaze storm. Here, damage—chiefly by bending—is quite apparent in a 25-year old stand of black cherry and sugar maple on the Kane Experimental Forest in Elk County, Pennsylvania. It resulted from a severe glaze storm that hit the Allegheny Plateau on February 13-14, 1950. Photograph was taken August 10, 1950.

past fires (*18*). Second-growth mixed oaks occupy sites that are dry and have also been subject to past fires. The most important forest association on the Allegheny Plateau today is the beech-birch-maple second growth, also called the Allegheny hardwood type. Black cherry and the maples are the most valuable species in this type (*13*).

Basis for Zone Delineation

Research conducted over a 30-year period in silvics and silviculture, harvest-cutting methods, and natural regeneration has revealed some of the main factors that influence the ecology and management of black cherry and its associated species. These studies, as well as local observations, reports, and discussions with private and public forest-land managers in the region, form the basis for delinating the various zones discussed here.

Once the critical elevation for glaze damage has been decided on, it is relatively easy to delineate this zone on a map.

Broad tree associations or forest types known to be unfavorable for black cherry are: (1) the mixed oaks, (2) the aspen-pin cherry-bracken fern association of old burns and frost pockets, and (3) the pure hemlock or hemlock-white pine type. The favorable forest type common on the Allegheny Plateau is the mixture of species known as "Allegheny hardwoods" or the "beech-birch-maple" type in which there is a large admixture of black cherry of seed-bearing size.

We can assume for practical zoning purposes that these cover types, whether temporary or permanent, provide us with enough information for forest management planning. Mapping of forest cover types with the aid of aerial photographs and checking delineations by field reconnaissance is well known to most foresters and will not be described here.

Basic to zoning is the knowledge that climatic, biotic, and site (topographic and soil) factors are expressed in the "site-type" or kind of vegetation found on a given area. Thus productivity or site quality, particularly for the management of black cherry, is essential in the method (*23, 24, 25*).

The critical elevation above which the frequency and degree of glaze damage become too great can only be set in a given locality by reference to past storm damage. Records kept by the American Telephone and Telegraph Company (*2*) show damaging glaze storms to be fairly frequent in a broad belt from north Texas to the Dakotas and east to the Atlantic north of Virginia.

On the northern Allegheny Plateau, a study of the effects of the severe glaze storm of March 1936 (*9*) showed serious damage to second-growth and older stands at elevations from 1,800 to 2,000 feet above sea level in western Pennsylvania and western New York (*10*). The same storm, as it reached central New York at latitudes from 42° 50′ to 43° 0′ north, severely damaged stands between 1,000 and 1,500 feet.

The glaze storm of December 27-30, 1942 in Otsego and Herkimer Counties, New York, badly damaged trees at elevations above 1,000 feet (*22*). In northern West Virginia on the Cheat Mountain Range, severe injury from glaze was restricted to stands located above 2,100 feet elevation during a storm in January 1956 (*6*). Farther south in the Appalachian Mountains glaze has occurred at elevations of 1,200 to 4,000 feet (*21*). A storm reported by Abell (*1*) in the southern Appalachians on December 17, 1932 damaged stands above 3,000 feet elevation. By contrast, in coastal New Jersey and the western shore of Maryland, glaze storms have occurred in stands at all elevations.

Studies made on the Allegheny Plateau following the heavy glaze damage by the storm of February 13-14, 1950 have revealed that stand age and species composition are important factors affecting the kind and degree of injury. There is a definite distinction between the kind and amount of glaze damage done to larger, more brittle black cherry of older-age classes as compared to that suffered by young pole and sapling stands. The older trees are usually badly broken in the tops, and occasionally forked boles are split at the crotch. Leaning trees are often uprooted. However, experience and detailed studies have shown that black

cherry stands 40 years of age or older recover rather well from all but the most severe glaze injuries (*4, 5, 8*).

This is not the case with young sapling and small pole-sized black berry—20 to 35 years old. Here, the worst glaze injury is *bending*. Top-breaking, fork-splitting, and uprooting are relatively unimportant (*17*). The bent-over stems seldom recover upright growth: they produce sprouts along their boles and thus have little or no future value (Fig. 2).

Thus, the risk of almost complete loss of the large saplings and small poles makes it advisable to zone for black cherry production on the basis of elevations below which glaze storms are less destructive.

Recognized Zones on the Allegheny Plateau

By the factors here described, five zones are commonly found in the Allegheny Plateau forests. Most important to the management of black cherry, Zone 1, is the Allegheny hardwood forest type below the critical elevation. The other zones cited are less favorable to black cherry management. The five recognized zones are:

1. Allegheny hardwoods below the critical elevation of serious glaze injury to young growth.
2. Allegheny hardwoods above the critical elevation.
3. Mixed oaks.
4. Aspen-pin cherry.
5. Hemlock.

The Allegheny hardwood forests of Zones 1 and 2 are similar in species composition, soils, site quality, and past stand history. The chief species are sugar and red maple, beech, yellow and black birch, and black cherry. Stands vary from young growth to remnants of the original forest. Site quality is generally good in the absence of repeated wildfire or local areas of poor drainage on claypan soils.

The all-important difference between Zones 1 and 2 is the greater glaze damage and poor recovery of to 20- to 35-year-old black cherry stands at the higher elevations (*10, 17*). During a given glaze storm, the weight of ice and consequently the damage by bending and stem-breaking is much greater in stands on higher ground.

The mixed oak type forms another area, Zone 3, in which it is difficult, if not impossible, to regenerate black cherry. The mixed oaks above the critical elevation are "double jeopardy" for cherry. Factors that make the mixed oak zone a poor risk for intensive management of cherry are: (1) the lack of black cherry seed trees; (2) relatively poor site conditions (*23*) with shallow rocky soils, steep south and west slopes, and a low water table; (3) a history of fairly frequent forest fires; (4) aggressive sprout growth of the oaks after cutting or fire; and (5) heavy deer-browsing.

The aspen-pin cherry forest type makes up a fourth zone on the Allegheny Plateau. This zone, a favorite of deer, is difficult to protect and improve. Past forest fires have swept the type at frequent intervals since the days of early logging (*18*). As a result, desirable species are relatively few and tree quality is low. Attempts to plant hardwoods in this zone have usually failed because of the severe microclimate and animal damage (*14*). Conditions are even less favorable here than in the mixed oak zone. Thus, it would seem unwise to attempt to propagate black cherry in this zone either by artificial planting or natural regeneration.

The fifth and final zone, which locally may be important, is the hemlock forest type. Stands of white pine or white pine-hemlock are similar to the pure hemlock type, but today on the Allegheny Plateau they seldom cover extensive areas. Silviculturally, these coniferous types are valuable as seed sources, and they do have commercial utility. But methods of converting them to black cherry have not been studied, and even if it were possible to perpetuate and manage such stands for black cherry the area involved is small. It would seem best to encourage the conifers and produce black cherry on other lands.

An Example of Zoning

Zoning by the method described has been applied to 702,000 acres of the Allegheny National Forest (Fig. 1). Fortunately, maps of topography and forest types, basic tools for zoning, were available for this portion of the plateau.

On the basis of glaze storm damage in 1936 and 1950, the critical elevation for black cherry management was fixed at 2,000 feet (*10*). Still, severe damage to saplings and small poles may occur below this level on north and east slopes, while some stands above 2,000 feet may be only slightly damaged if they are on the warmer south and west slopes. Nevertheless, in this example we have not attempted to show zones in minute detail based on both aspect and elevation. Rather the critical 2,000 foot contour seemed a sufficient guide as to glaze zones influencing black cherry management.

The first step in zoning this forest area was to trace the 2,000-foot contour from U. S. Geological Survey quadrangle maps onto a base map of the same scale. Once the area lying above the critical elevation had been delineated, the extent of cover such as the "mixed oak," "aspen-pin cherry," and hemlock types was shown. In this case the broad cover types, corresponding to groups listed by the Society of American Foresters, had been marked on topographic maps by the Northeastern Forest Experiment Station's forest survey field crews in 1947. Subsequent field checks have shown practically no change in the area distribution of these types. Changes have occurred in volume growth and size classes of the timber, but the major species composition has changed little, if any, during the last decade.

The final result is a map showing in some detail the location of the various zones to be considered in the local management of black cherry (Fig. 3). The unshaded area in Figure 3, designated as Allegheny hardwoods, is the most

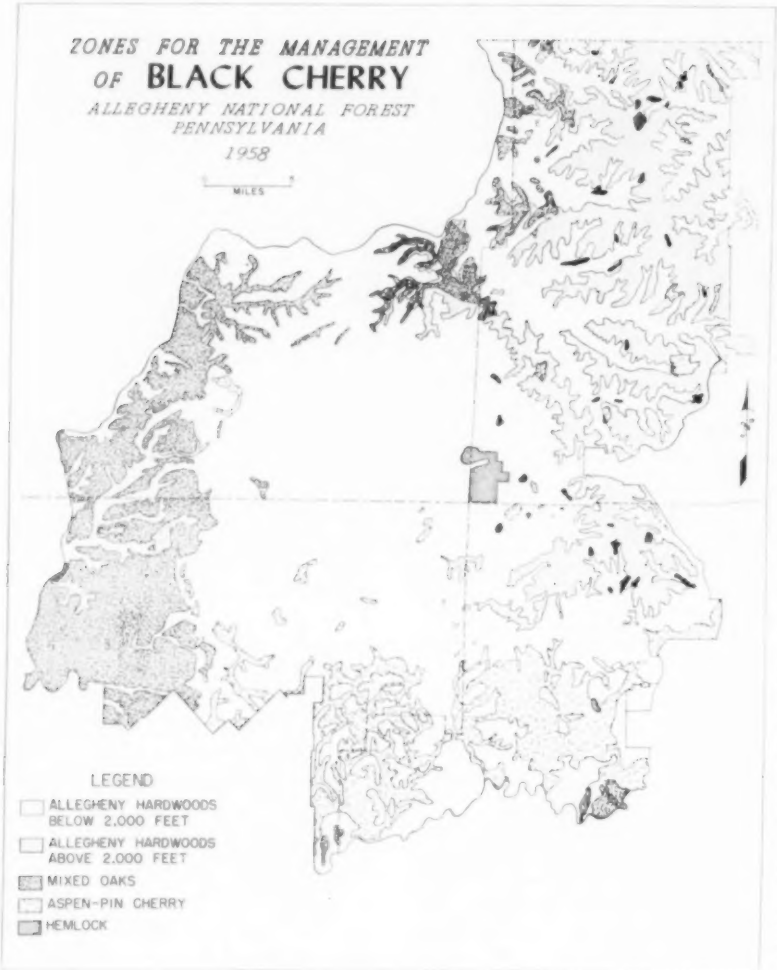

FIG. 3.—Critical elevation and forest associations were used as the basis for delineating zones suitable for perpetuation of black cherry.

favorable zone for continuous production of young age classes of black cherry.

An estimate of the acreage in each zone was prepared by the grid dot count method. The results show that 59 percent (415,700 acres) of the total sample area is most favorable for black cherry management (Table 1). It is here that the landowner or forest manager should concentrate his efforts to reproduce and grow successive crops of this high-value cabinet wood.

Still, cherry as well as other species do grow into valuable well-stocked sawtimber stands above 2,000 feet elevation, as demonstrated by their presence on the Allegheny National Forest. If saplings and small poles above this critical elevation escape severe glaze damage and are otherwise protected and managed, they can be expected to develop into sawtimber.

Although the zoning procedure described here outlines the areas most favorable for cherry, some further refinements must be observed during the intensive management program necessary for the success of this species.

TABLE 1.—AREAL DISTRIBUTION OF MANAGEMENT ZONES ON ALLEGHENY NATIONAL FOREST

Zone	Area	
	Acres	*Percent*
1. Allegheny hardwoods below 2,000 feet	415,700	59.2
2. Allegheny hardwoods above 2,000 feet	116,100	16.5
3. Mixed oaks	98,300	14.0
4. Aspen-pin cherry	65,000	9.2
5. Hemlock	7,400	1.1
All zones	702,500	100.0

Recommendations

Past studies of the silvical characteristics of black cherry and the silvicultural practices best suited to its successful regeneration and development have shown:

1. The most favorable situations for black cherry regeneration are good sites, especially moist, fertile, lower slopes on north and east aspects. On the other hand, boggy or swampy sites of slow drainage or sites with gley layers within 12 inches of the soil surface are unsuited to regeneration or successful growth of black cherry (*26*, *17*).

2. Method of cutting is a prime factor in managing for black cherry; the only known successful cutting method is the use of small circular openings or narrow strips. This is probably due to the early requirements of cherry for light and growing space concurrent with protection from the climatic extremes found in larger clearings. To obtain the needed microclimate, circular openings should not be much over 1 chain (66 feet) in diameter or strips not wider than 1 chain. Birds commonly visit such openings and disperse cherry seed (*14*, *17*). The minimum size of opening is not known; but according to observations in old-growth stands, removal of one or two adjacent mature trees can result in successful black cherry reproduction. If the strip system is used, orienting the strips up and down slopes will reduce damage of young growth from glaze breakage of larger timber along the edges (*17*).

3. Stand size, age class, or species composition within the Allegheny

hardwoods type are secondary factors in the success or failure of black cherry production. Generally, it is a better practice to convert a stand of relatively poor-quality trees to desirable black cherry regeneration than to attempt to convert a fast-growing, well-stocked stand of high-quality desirable species to cherry. Mixtures of low-grade holdover beech, sprout maples, and low-vigor birches offer good possibilities for regeneration of black cherry. Stands in the 40- to 60-year age range may be converted as well as older stands.

4. Good cutting methods alone will not assure successful cherry regeneration. The chief cultural measures necessary are: early elimination of stump sprouts overtopping seedling black cherry; crop-tree weeding or cleanings to favor selected individuals; and stand-improvement thinnings to remove defective trees or poor species and to maintain growth of the selected individuals (*7, 11, 12, 15, 20*).

5. Protection of reproduction from deer browsing is also essential (*16*). Slash left in place will help, but fencing is necessary where deer populations are excessive—as they are in many Allegheny Plateau forests. A woven-wire fence that can be moved from one opening to another every five years or so will permit black cherry to grow above deer-damage height. Trees can be used for posts to save labor and material costs. The outrigger type construction has possibilities for reducing height of fence (*3*).

6. In addition to zoning for glaze protection, it would be well to avoid creation of too large an area of regeneration that will reach the glaze-susceptible age class (20 to 35 years) all at one time. Both above and below the critical elevation, spreading regeneration cuttings over a fairly long time period will give added insurance against glaze damage.

Summary

A method of zoning forst land is proposed for use in the Allegheny Plateau region of northern Pennsylvania and southwestern New York. This method identifies areas favorable and less favorable for the perpetuation and management of repeated crops of black cherry. Elevations below which glaze damage to saplings and small poles is less serious are zoned as most desirable unless in the mixed oak, aspen-pin cherry, or hemlock forest types.

As an example of this method, 702,000 acres within the boundaries of the Allegheny National Forest have been zoned in detail. Of the total area, 59 percent was found to be in the zone most favorable for continued black cherry production and 41 percent in the less favorable zones.

Recommendations are given for the intensive management of black cherry. The questions of physiographic location, site, soils, methods of cutting, microclimate, stand condition, species composition, cultural practices, and protection are covered briefly.

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The Consumer's Attitude Toward Wood in House Foundations[1]

Joseph Zaremba

LUMBER PRICES in the United States have been marked by two principal characteristics during the past century: the extreme fluctuations in prices and the long-time rise in lumber prices relative to both all-commodity prices and prices of competing materials.

It is true that since the mid-1950's lumber prices, responding to a slight falling off in demand, have remained fairly stable. But in view of the past behavior of lumber prices, and indeed the continuing action of the forces underlying the lumber-price trend, it can be expected that this leveling off is temporary and that prices will eventually resume an upward course.

A continuing long-time relative rise in lumber prices will place the lumber industry in a progressively weaker marketing position with respect to the manufacturers of competing materials.

Two things might be done to improve the competitive position of lumber or slow the rate of deterioration in lumber's competitive position. The industry might raise its productivity, thereby lower its unit costs of production, and thus slacken the rise in lumber prices. In addition, the quality of lumber and of wood products might be improved and a greater effort made to offer the consumer the kinds of wood products which best fit his needs and tastes. Consumer preference for wood products may thus be strengthened so that consumers would become less sensitive to high prices.

The prospects for increasing productivity do not appear promising, particularly in the immediate future. Improvements in logging and milling technology are, if anything, barely managing to counteract continuing adverse trends in timber size, quality, and location. Real progress may have to await a general awakening on the part of both industry and the public to the size and scope of the task. Meanwhile, the second alternative—strengthening consumer preference—emerges as the more feasible approach to the problem. Even if productivity were increasing, the need for strengthening the consumer's attitude would still be important, though perhaps less urgent.

The consumer is a complex individual and is not readily understood. Moreover, the consumer's attitude toward wood varies greatly from one use to another, which makes the attainment of a comprehensive understanding all the more difficult.

In a previous paper geographic differences in materials used for exterior walls of dwellings were examined.[2] It was found that homeowners in New Haven, Connecticut, are strongly attached to wood-exterior houses and show scarcely any interest in masonry. On the other hand, homeowners in Delaware County, Pennsylvania (near Philadelphia), are firmly attached to masonry and do not, in general, buy wood-exterior houses despite their lower cost. This complete turnabout in preference within a relatively short distance seems to be the main cause of the difference in materials in the exterior walls of houses in these two areas. This analysis suggests, among other things, that price sometimes has a relatively minor influence upon consumers' choices of construction materials.

This article examines the consumer's attitude toward (or interest in) wood in another part of the house, namely, the foundation. The foundation, here, includes the floor joists, subflooring, and finished flooring found in conventional houses.

Of the three types of house foundations in common use—basement, crawl space, and concrete slab—the crawl space ranks highest in wood requirements and the concrete slab lowest. The slab takes the place of the floor joists, subflooring, and often the flooring itself. About 23 percent less wood is used in the construction of a slab house than in the construction of a crawl-space house of equivalent size.

In the remaining sections, attention is centered first on the geographic variations in house foundations. An attempt is then made to evaluate the causes of these variations. Finally, several inferences are drawn concerning the significance of the findings to the lumber industry and the forestry profession.

Survey of Foundation Types

The geographic distribution of house foundations was determined from a nation-wide survey of building inspectors undertaken in 1955. Questionnaires were sent to the building inspectors of all cities (about 2,200) having a population of 6,000 or more (1950 Census) and, additionally, to 400 county and township inspectors. The re-

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[1]In this article is presented a portion of the findings of a study in wood consumption by the construction industry. It is based on a thesis submitted to Harvard University in partial fulfillment of the requirements for a Ph.D. degree in economics. The field work was supported by a grant from the United States Forest Service. The writer is indebted to S. O. Heiberg and G. H. Smith, State University of New York, for suggestions in the preparation of this article.

[2]Zaremba, J. The consumer's attitude toward lumber in exterior walls of houses. Jour. Forestry 57:90-93. 1959.

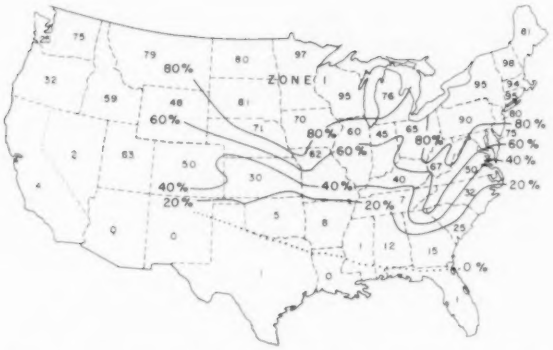

FIG. 1.—The percentage of single-family houses built during 1954 with basements. Zone 1 refers to the northern sector of United States where basement houses are predominant.

FIG. 2.—The percentage of single-family houses built during 1954 with crawl spaces. Zone 2 refers to the middle South where crawl-space houses are most common.

turns from the survey, after the non-respondents were followed up, was 70 percent. About 60 percent of all single-family houses built during 1954 were covered by the survey.

The building inspectors were asked to give the percentage or number of single-family houses built during 1954 with each foundation type and to explain the use of foundation types. The percentage of each foundation type in new construction in each state is shown on maps of the United States: basements in Figure 1, crawl spaces in Figure 2, and concrete slabs in Figure 3. A re-survey of building inspectors in 1958 revealed no significant change in these patterns.

Survey Findings

The survey findings depict three geographic zones: Zone 1, northern United States, where basement houses are predominant; Zone 2, middle United States, where crawl-space houses are most common; Zone 3, southern United States, where concrete-slab foundations predominate.

A comparison of Figure 1 with a mean-winter-temperature map (Fig. 4) indicates that basements decline in use mostly in the winter-temperature range from about 25 to 35 degrees. Notice, first, that the relatively rapid decline in basements from 80 percent to 20 percent in the Great Plains corresponds to a relatively rapid increase in mean winter temperature from about 25 to about 35 degrees; the more gradual decline in basements in the north-central area corresponds to a more gradual increase in temperature. Second, in western Washington, where the mean winter temperature is about 40 degrees, the proportion of basements is 25 percent; while in eastern Washington, where the mean winter temperature is 30 degrees, the proportion is 75 percent. Finally, the percentage of basements increases from about 20 percent in eastern Virginia, where the mean winter temperature is about 40 degrees, to almost 80 percent in western Virginia, where the mean winter temperature is about 30 degrees.

The predominance of basements in Zone 1 appears to be due to the economical and effective house heating made possible by this type of foundation. In areas with mean winter temperatures less than 25 degrees, satisfactory heating evidently requires that the space under the floors be sealed from the cold outside air and kept warm. In a basement house this space is kept warm in winter and there is no chance for cold air to penetrate into the house from below. The

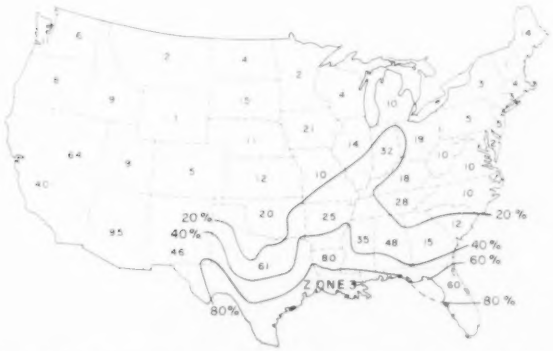

FIG. 3.—The percentage of single-family houses built during 1954 with concrete slab foundations. Zone 3 refers to the far South where slab houses predominate.

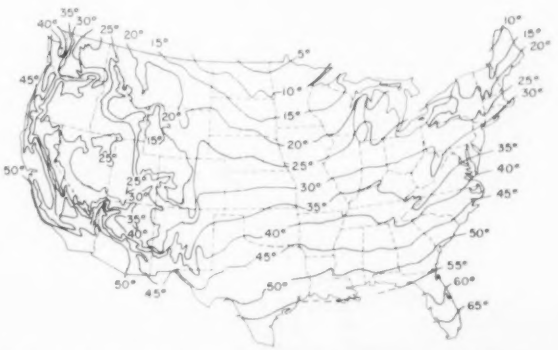

FIG. 4.—Average winter temperature, December to February, inclusive. (Source: U.S. Dept. Agric. 1936. Atlas of American Agriculture. p. 8.)

plumbing is also protected from freezing.

The space in the basement, it is true, finds wide use among homeowners in the North. But the desire for utility space in the basement is not, as is generally believed, the overriding factor underlying the predominance of basements in Zone 1. Certainly homeowners in Zone 2 have a need for utility space. But here such space is located in utility rooms on the first-floor level. Homeowners prefer to have utility space on the first floor to save walking up and down stairs.

The concrete-slab foundation as presently built does not, in the consumer's mind, provide the quality of heat in Zone 1 that basements provide. The danger of frost-heaving also militates against the use of slabs in many northern areas. The edges of a properly-built slab must be set into the ground at least down to the frost line to safeguard the slab against cracking when the earth heaves. Where frost penetrates to a depth of as much as 5 feet, as it does in the north prairie states, satisfactory slab construction would be very expensive.

A comparatively new development in home construction provides evidence of the importance of warm air under the floors in cold weather. In the North Central States some builders are now marketing a heated crawl space: A vapor barrier is laid over the ground surface to keep the water out of the crawl space; closable vents are installed, and the plumbing is not insulated. Provision is then made for circulating warm air into the crawl space during winter months. This prevents the plumbing from freezing and keeps cold air away from the lower floor surface.

In areas with mean winter temperatures above freezing—characteristic of Zones 2 and 3—effective house heating can be achieved without a basement. Thus slab or crawl-space construction is encouraged.

There seem to be two reasons for the widespread use of crawl-space houses and the limited use of slab houses in Zone 2. First, cold floors, although causing less concern here than in Zone 1, are still a widespread complaint against the concrete slab. Homeowners in this comparatively cool climate object to the cold feeling of the asphalt tile that is commonly used to cover the slab. Furthermore, water condensation on the concrete inside the house may sometimes create problems.

The second reason for the wide use of crawl-space houses in Zone 2 is that hardwood floors serve popular tastes and preferences far better in cool climates than asphalt-tile floors do. Incidentally, hardwood is more resilient than asphalt tile, and it is generally believed that hardwood floors are less tiring on the feet.

Although hardwood can be installed on concrete, and indeed the technology is highly developed, in Zone 2 this type of construction is apparently not a substitute, in the consumer's mind, for the conventional wood floor in crawl-space houses. The concrete slab does not provide as good a base for hardwood floors as does the structural framework of the crawl-space foundation.

The popularity of slab houses in Zone 3 is explained largely by three factors. First, in some areas, notably in Texas and California, earth movements occur following dry seasons. During the long dry periods the soil has a tendency to shrink and crack. When rain comes, the soil around the outside of the house becomes soaked and is capable of exerting an upward pressure, while the soil under the house remains relatively dry. As a result, there is a tendency for the outside foundation of the crawl-space house to be pushed upward while the interior of the house remains relatively unmoved. Cracks develop in the walls; doors and windows stick; and the baseboard separates from the floor. In the case of the slab house, however, when earth movements occur, the entire slab moves — that is, it is said to "float." In such areas, therefore, consumers greatly favor slab foundations over crawl-space foundations.

The second factor is that there is no serious heating problem in the warmer climate of Zone 3. Asphalt tile, with its cold feeling and lack of resilience, is apparently successfully avoided, if necessary, by the installation of hardwood or carpeting on the concrete.

The third factor accounting for the popularity of slab houses in Zone 3 is the possibility of termite damage to the exposed wood in the crawl-space foundation.

It seems, then, that although slabs came into the market strongly after World War II, they have met with marked success only in the South. There they made their gains largely at the expense of crawl-space houses. The proportion of basements seems to have held constant.

Furthermore, consumers may not switch to slabs simply because they are cheaper. Most of the consumers in Zone 1 do not regard the slab as a substitute for the basement. And most of those in Zone 2 do not look upon it as a substitute for a crawl-space house. Perhaps some day builders will develop a type of foundation which is relatively cheap and generally acceptable to consumers in the north and central latitudes. The slab foundation as presently built, however, is not this development.

Indeed, one wonders if slabs will even hold their own in the future. A recent report by the Bureau of Labor Statistics indicated that 16 percent of the single-family houses built throughout the country during the first quarter of 1955 had slab foundations,[3] whereas in 1953, according to the Stanford Research Institute, 34 percent of all houses were built on slab.[4] These data suggest, if anything, a downward shift in slab construction for the country as a whole.

We have, then, in consumer tastes as affected by climate and

[3] U. S. Department of Labor. New housing characteristics in 1955 and earlier years. Monthly Labor Review. July 1956.

[4] Stanford Research Institute. America's demand for wood. p. 98. 1954.

ground conditions, a powerful determinant of consumption which, apparently, is capable of relegating price to a secondary role.

Analysis of Results

The building element which supports the floor may be of a material different from the actual floor surface. It is advisable, therefore, to separate the discussion of wood use in the lower building element, below the floor surface, from that of the actual floor surface. The wood in the lower building element of crawl-space and basement foundations is mainly structural wood and board (or plywood) subflooring; the floor surface usually consists of hardwood flooring. The lower building element in slab construction consists entirely of concrete; while the floor surface may be either hardwood flooring or various types of non-wood covering such as asphalt tile or linoleum.

Lower building element.—According to the study findings, the main functions of the lower building element are: to provide support for the floor surface, to give rigidity and stability to the house, and to give protection against the climatic elements—particularly to facilitate good-quality heating inside the house.

The consumer's primary interest in the lower building element is to have a structure that can perform its functions well. Beyond this functional aspect consumers are not greatly concerned over the kinds of materials used in constructing the element, except in certain localities in the far South where excessive termite damage has built up a strong prejudice against wood, even well-treated wood which resists termites.

The kinds of materials used for constructing the lower building element are determined primarily by building technology. In crawl-space and basement foundations, wood's place seems assured by existing technology. But the technology of constructing concrete slab foundations rules out the use of wood entirely in the lower building element.

The preservation of the market for wood in the lower building element hinges on how successfully basement and crawl-space foundations perform their functions relative to concrete-slab foundations. To safeguard the market may require that the effectiveness of these two types of foundations be maintained or even increased. Continuing improvements in wood quality, engineering, and workmanship are called for. Where basement and crawl-space foundations excel, informational and promotional campaigns may be required to break down unfavorable attitudes toward wood.

The floor surface.—Consumer preference for specific materials seems to be the decisive factor in the selection of the floor surface. The desired attributes of the floor are warmth, residience, and attractiveness. Hardwood floors, mainly of oak, possess these attributes and have a long history of satisfactory service to homeowners.

However, the intensity of the consumer's preference for these attributes varies with climate, being greater in cool than in warm climates. Thus, in the very warm southern areas, many homeowners are satisfied with a non-wood floor surface, such as asphalt tile, laid on the concrete slab.

In areas where soil conditions and the fear of termites give rise to slab construction, and where the preference for a hardwood floor is also strong (for example, central Texas), hardwood is generally installed on the concrete. But, as noted, hardwood on concrete does not give complete satisfaction to homeowners. Hardwood floors serve homeowners best when the flooring is fastened to subflooring and floor joists as it is in basement and crawl-space houses. Thus, where soil conditions and other factors are favorable to crawl-space construction, the strong preference for the hardwood flooring-floor joist combination appears to be an important factor underlying the consumer's decision to adopt the crawl-space foundation. The reluctance of consumers to accept the hardwood flooring-concrete slab combination as a substitute for the hardwood flooring-floor joist combination is probably one of the main factors reversing the trend in slab construction in moderately cool climates such as that of central United States and the far West.

Some Implications of Findings

A strong consumer preference for oak flooring is one of the major factors in preserving the market for wood in the floor surface of single-family houses. This preference for oak flooring has, moreover, kept the housing market relatively safe for crawl-space houses in many areas.

Maintenance of this preference depends to a large degree on the availability of good-quality oak flooring. With an expected annual market of 2 million dwelling units by 1975 (compared with about 1 million today), there is a tremendous potential market for hardwood flooring, and indeed structural wood, in house foundations.

A marked step-up in forest management on much of America's forest land may be required to fill the demand for flooring and structural wood and thus preserve that portion of the housing market for wood. Some improvement in quality can, no doubt, be achieved in lumber and wood products manufacturing. However, the inability of manufacturing technology to improve quality sufficiently by itself is evidenced by the growing concern of industry over the low quality of lumber harvested from much of America's forest—a condition which might have been avoided or at least partially arrested by having taken steps long ago to build up the quality of forest growing stock.

In the past a strong impact of consumer preference has usually been necessary to create among manufacturers an awareness of consumers' needs. By the time such awareness develops, however, it is too late for foresters to contribute to an immediate improvement in the product.

Foresters need to anticipate consumer preferences before their impact is felt by manufacturers and

wood processors. The responsibility for the anticipation of preferences, and the implementation of plans to satisfy them, might well be shared by both foresters and manufacturers.

Will consumers be willing to pay the cost of growing more and better timber? To this question only a few general comments are possible. In the past, an increase in the price of lumber has generally been less detrimental to consumption than a deterioration in consumers' attitudes. Moreover, as incomes increase, preference becomes more and more important in the determination of consumers' choices, because, with rising incomes, preferences for various products can be expressed more freely into effective demand for those products. Thus, if preference for wood products can be maintained or strengthened there should be little fear that consumers will not be willing to pay a higher price for the better quality. Rising prices do not always deter consumers—particularly well-informed consumers—in their pursuit of quality.

Furthermore, improvements in manufacturing technology and the production of quality timber may not necessarily lead to higher lumber costs to consumers because, in the process, labor productivity will undoubtedly increase. Net lumber costs will rise to the degree that manufacturing and timber-growing unit costs increase at a faster rate than productivity.

Summary

One way to advance lumber's competitive position is to improve the quality of wood and wood products, and also the services that wood structures render to consumers. Consumers may thereby tend to develop a greater admiration for wood (and wood structures) and become less influenced by price.

This article examines the consumer's interest in house foundations of single-family houses. The consumer's main interest in the lower building element is for a structure which can perform certain functions essential for good household living. Consumers are not greatly concerned about the kinds of materials used in constructing the element except in the far South where termite damage has built up a strong prejudice against wood. The market for wood in the lower building element of single-family houses can best be preserved by maintaining or increasing the performance of basement and crawl-space foundations.

On the other hand, consumers are very much interested in the materials used for the floor surface. Maintaining a strong preference for hardwood flooring seems to offer the best assurance of preserving the market for wood in the floor surface.

If the forests of America are to contribute more to the public good, and if the forest industries themselves are to be put on a more secure economic footing, foresters as well as manufacturers of wood products must become more and more conscious of the kinds and qualities of forest products that are preferred by consumers; foresters must then strive to produce the kinds of wood that can best satisfy those preferences.

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Stumpage Appraisal on the U.B.C. Research Forest[1]

R. S. Wood and J. W. Ker

SINCE 1953 an increasing number of timber sales of forest products have been made on the University of British Columbia Research Forest at Haney, B. C., in implementation of the plans for its management. These sales provide the necessary funds for managing and developing the area, as well as for research on the forest, part of which is done by graduate students working in forestry.

The first relatively large timber sale, with a final scale volume of 11.5 million board feet, was made in 1953. The appraisal of stumpage value on this sale was made by a modification of the Rothery or operating-ratio method, and competitive bids were taken by sealed tender. Experience with this sale made it apparent that the method of appraisal, the method of awarding the contract, and the financial returns to the University left much to be desired.

First, it was felt that bids by sealed tender result in a bid price that might be considerably less than one arrived at through open bidding. Secondly, although the sealed tender allows the seller some latitude in choosing the operator, there does exist a moral obligation to accept the highest bid. This means that the most suitable operator might be excluded even though in open bidding he might have offered more than the highest tender. The third disadvantage lies in the appraisal system itself, wherein underestimation of timber volume and grades works to the disadvantage of the seller. Fourthly, the sliding-scale formula used may not always compensate adequately for changes in selling prices. Finally, an average stumpage price is entirely dependent upon the grade percentages estimated in cruising the sale and both high-value and low-value products of the same species pay the same stumpage price.

In April 1956, it was decided to develop a new method of appraisal that would eliminate most of the above-mentioned disadvantages and that would include, if possible, several new features advantageous both to the operator and to the University. Ideally, such a system would be designed for saw-log sales of less than seven million board feet, would be sensitive to every change in selling price and costs, and would be applicable to timber sales with somewhat flexible boundaries. In apportioning fixed costs, it would eliminate the necessity to rely solely on cruise estimates of volume and grade, and it would encourage the operator to achieve the highest possible level of utilization compatible with the conversion return[2] available under existing market conditions.

The New Method

Three basic elements are involved in stumpage appraisal: (1) selling price of the products; (2) costs of production; and (3) the share of the conversion return, (1) minus (2), to be apportioned to the operator as profit and risk and to the seller as stumpage.

In the method used on the University Forest, a range of possible selling prices of major products available on the sale area is first established. For example, this may range from the price of No. 1 fir peelers to that of No. 3 shingle-cedar logs. The upper and lower limits of the range are established at a "safe" distance beyond these current prices, e.g. $120 per M. as the upper and $35 per M. board feet as the lower limit. A schedule of selling prices is then set up using a class interval of $5, e.g., $35, $40, etc., with class ranges of $32.51 to $37.50, and so forth.

From the mid-point of each selling-price class the appraised logging cost, including both variable and fixed costs, is deducted to find the average conversion return for the class. This conversion return is then divided between stumpage and operator's margin by applying a profit-and-risk factor that will be discussed further.

Logging costs are determined in a manner similar to that used by the British Columbia Forest Service. Costs of felling, bucking, yarding, loading, hauling, booming, and towing are estimated for an operator of average efficiency. Because the timber sales are situated within a relatively small area, it is possible to arrive at accurate costs based on experience on adjacent sale areas. The logging cost is expressed on a per-unit basis, e.g., $20 per thousand board feet.

The total cost of road building is then estimated on the basis of recent road-building contracts. The road costs are then "written off" against *less* than the estimated total volume on the sale area. For example, if the total cost of road construction, to standards to be specified in the contract, is estimated to be $10,000 and the total volume to be removed is estimated to be five million board feet, the total cost might be charged to the first 2.5 million board feet. If so, the road cost would be four dollars per thousand board feet on

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[1]Research Note No. 20, Faculty of Forestry, The University of British Columbia.

[2]Conversion return is defined as the difference between selling price and total costs of production.

TABLE 1.—EXAMPLE

Logging cost	$20 per M Bd. ft.
Road cost	4 per M Bd. ft.
Operating cost	$24 per M Bd. ft.

Selling price range $35 to $120 per M
Valuation factor 0.60
i.e., stumpage 60%, margin for profit and risk 40% of conversion return.

Selling price class	Class range	Operating costs	Conversion return	Stumpage	Margin for profit & risk
		$ per M bd. ft.			
120	117.51–122.50	24.00	96.00	57.60	38.40
115	112.51–117.50	"	91.00	54.60	36.40
110	107.51–112.50	"	86.00	51.60	34.40
105	102.51–107.50	"	81.00	48.60	32.40
80	77.51– 82.50	"	56.00	33.60	22.40
75	72.51– 77.50	"	51.00	30.60	20.40
65	62.51– 67.50	"	41.00	24.60	16.40
60	57.51– 62.50	"	36.00	21.60	14.40
40	37.51– 42.50	"	16.00	9.60	6.40
35	32.51– 37.50	"	11.00	6.60	4.40

During a particular month the following volumes of Douglas-fir saw-logs are logged and scaled:

Volume, M bd. ft.	Log Grade
107	1
305	2
85	3

During the same month Douglas-fir log prices on the Vancouver market are reported to be:

Log grade	Average selling price, per M bd. ft.
1	$80.00
2	61.50
3	42.50

As royalty payable is $3, $2, and $1, per M on log grades 1, 2, and 3, respectively, net selling prices become:

Log grade	Net selling price, per M bd. ft.
1	$77.00
2	59.50
3	41.50

These prices belong to the 75, 60 and 40 dollar classes, respectively. Consequently stumpage is calculated as follows:

Log grade	Calculation	Total stumpage
1	$30.60×107	$3,274.20
2	$21.60×305	6,588.00
3	$ 9.60× 85	816.00
		$10,678.20

the first 2.5 million board feet removed. As soon as this volume has been logged and the road cost recovered by the operator, the stumpage on the remaining volume would be adjusted accordingly.

At this point, logging costs ($20) and road-building costs ($4) are combined to give the total cost ($24) applicable to the first 2.5 million board feet removed. These costs are now inserted in the table of selling prices and the conversion return for each class is determined.

The remaining step in the appraisal is to determine the appropriate division of conversion return between stumpage and the margin for profit and risk. This is done by considering several factors such as difficulty of the logging chance, the value of products to be removed, and the length of the logging season. In this, reliance must be placed upon the experience and judgment of the appraiser, who must give due consideration to the risks undertaken by the operator and assure him a fair return on his invested capital.

The ratio between stumpage price and conversion return is called the valuation factor. In the B. C. Forest Service method this factor is required to be between 0.40 and 0.60. This arbitrary limitation may not be justifiable in all cases.

The valuation factor may also be varied according to selling price on a single sale area, and thus provide a higher proportion of the conversion return for stumpage on the more valuable products and a lower proportion on the less valuable products. This enables the seller to gain increased stumpage revenue on the higher values while making the removal of the lower valued products more attractive to the purchaser of the stumpage. By proper manipulation of the margin for profit and risk in this manner the utilization of forest products of marginal value may be encouraged.

Application of the Method

With this method of appraisal, it is apparent that competitive bidding is nearly impossible. It is most useful on a "first refusal" basis in which the seller, in this case the University, may approach the operator of its choice and offer him the sale at the appraised prices. In this way the most desirable operator, i.e., one that has proved to be reliable, efficient, cooperative, and financially sound, may be chosen.

In addition to the usual contract provisions for compliance with ordinary legal and special silvicultural and fire-control requirements, two contract clauses are an inherent part of the method:

1. An agreement that the stumpage price will be revised as soon as the road costs are paid (in the above example, when 2.5 million board feet have been removed).
2. An agreement that the operator will follow a staked road loca-

tion and will construct the road to specified standards.

Once the agreement has been signed, the road constructed, and logging started, the procedure is as follows.

At the end of each month, stumpage and royalty records are obtained from the Forest Service for the material removed and scaled during the month. The scaled volumes are then arranged by species and grade. Average log prices on the Vancouver log market are obtained for the month for each species and grade. This information is used to determine the total stumpage payment owing for the month:

1. Royalty payable is deducted from the selling price.

2. The net price (selling price less royalty) is inserted in the stumpage schedule and the stumpage rate determined for each selling price class.

3. The volume of each species and grade removed during the month is multiplied by the appropriate stumpage rate and these products are added together to give the total stumpage payment for the month.

4. Royalty is paid by the contractor. See Table 1.

[a] "Royalty" as used in British Columbia is the equity in old-growth timber retained by the Crown, i.e., the Provincial Government, irrespective of any alienation of land or timber. For example, on lands acquired subsequent to March 1, 1914, west of the Coast Range, the current royalty rates for Douglas-fir sawlogs is $3 per M. board feet for No. 1, $2 for No. 2, and $1 for No. 3, based on official (Forest Service) log grades.

Discussion

This method of stumpage appraisal is best suited to timber sales of 2 to 7 million board feet where competitive bidding is not employed. Competition could be introduced by having the operators bid on the margin for profit and risk. For example, if the appraised or "upset" valuation factor is set at 0.50, the seller will accept a minimum stumpage amounting to 50 percent of the conversion return. Various operators might be willing to pay more for stumpage by raising the valuation factor "bid" to 55, 60, or 65 percent of the conversion return.

Application of the method involves a monthly re-calculation of total stumpage. This calculation eliminates the necessity of sliding-scale provisions. Reliance upon exact cruise volumes and grade proportions is eliminated because the road cost is written off on less than the total volume. Stumpage is paid according to value of the product removed, high-value products paying the highest rates. By manipulation of the factor for profit and risk it is possible to encourage closer utilization of low-value products.

From the viewpoint of the contractor, the system has several advantages. First, he is aware of the estimated costs of logging and road-building which he must meet efficiently. Secondly, the method of appraisal is simple, straight-forward, and readily understood by seller and buyer alike. Thirdly, the operator is aware that the stumpage rate is based on the average Vancouver market price, so that if he can sell his logs at a premium he will increase his profit accordingly. Finally, the operator knows that he is being allowed a reasonable margin for profit and risk, and that his performance and compliance with contract conditions will count when subsequent timber sales are being awarded.

Conclusions

This system is operating successfully on the U.B.C. Research Forest. Silvicultural and fire control obligations have been discharged effectively; the stumpage revenue produced has been entirely satisfactory; the contractors have been well satisfied. The main advantages to the seller are increased cooperation from the contractor and the assurances that a fair revenue will be produced on all timber products removed and that there is little danger of loss of revenue should the cruise estimates of timber volumes and grades prove to be incorrect. On the other hand, the operator is assured a reasonable profit, provided that he maintains an efficient operation. In addition, if he wishes, the operator may speculate on changes in the log market by holding logs, on which he has paid the stumpage, in anticipation of a market rise.

Loblolly Pine Tracheid Length in Relation to Position in Tree[1]

L. W. R. Jackson

CONIFER tracheid dimensions have been a subject of investigation throughout the world for over 80 years. Tracheid length is known to be an important factor in quality of wood used for pulp, and shrinkage and strength properties of wood (*3*). A summary of previous work on fibers by Spurr and Hyvarinen (*4*) revealed that tracheid length varies widely with position in stem as well as between individual trees selected at random. Wardrop and Dadswell (*5*) reported that if the tracheids in the first ring were long, they remained longer in successive rings than those in stems with short tracheids in the first ring. In the interest of selecting trees of superior quality, an investigation was made of tracheid length variation in relation to position in stem and branches of loblolly pine (*Pinus taeda* L.).

Procedures

Wood samples were taken from loblolly pine plantings located on the Forestry School properties near Athens, Georgia. Relation of tracheid length to age of ring and height in stem was obtained by taking discs at approximately 4-foot intervals from stems of two superior 24-year-old trees. Samples were taken at every third ring from the periphery to the first ring around pith. By this procedure, the tracheids at all heights in a specific annual increment were formed in the same growing season. Each ring was separated into springwood and summerwood. One of the stem-branch relationships was determined by comparing the first-ring tracheids in the 1956 branch and stem growth taken from 48 five-year-old trees. In another series, the 1956 stem-branch samples were taken from 48 trees ranging in age from 2 to 16 years.

Maceration, mounting, and measurement of tracheids were done according to the procedure described by Jackson and Greene (*1, 2*). Excellent staining was obtained later by adding a few drops of Delafield's hematoxylon to a 5 ml. aqueous suspension of tracheids.

Results

Relation of tracheid length to position in stem.—Length of tracheids in springwood and summerwood within each ring of both trees increased from the first ring at the center to the periphery ring at all heights sampled, as shown in Figures 1 and 2. Tracheid length maxima, which ranged from 4.44 to 5.25 mm., occurred in the outermost ring at heights of 9.5 to 27.0 feet, inclusive. The shortest tracheids with a length range of 1.35 to 1.84 mm. were in the first ring from the pith.

Tracheids in the first ring from the pith showed much less variation with height in stem than the successive annual increments. In loblolly pine, there was no summerwood formed in the first and second ring of the stem at any height. In both trees, the length increased from 1.39 and 1.38 mm. at the 1-foot level to maxima of 1.77 and 1.84 mm. at 27 feet and then decreased to 1.35 and 1.43 mm. at the topmost levels of 54.0 and 49.5 feet. Tracheids in the first ring have the same anatomical form as those in the older ring. These results showed that the length of the tracheids in the first ring from the pith can be used for comparative purposes.

In each of the annual increments sampled, the tracheid length increased from the base of the stem to a certain height and then decreased to the top. Height of each length maximum increased with each successive annual increment from the center to the periphery. In the outermost ring the maxima occurred at heights of 22 and 27 feet, although there was little difference in tracheid length between 10 and 30 feet.

There was no significant difference in average length of all the springwood and summerwood tracheid pairs in each of the two trees. The "t" values for the 46 and 43 samples in the 2 trees were 0.066 and 0.107, respectively. There was no definite relation between difference in springwood and summerwood tracheids within rings and either age of annual increment or height in the stem (Fig. 1 and 2).

Stem-branch tracheid length relationship.—One of the major problems encountered in the study of the inheritance pattern of the anatomical features was how best to collect wood samples without severely damaging the parent or progeny. This raised the question of whether or not the first ring of branches can be reliably used as a basis for estimating tracheid length of the stem. According to Spurr (*4*), most investigators found that the fibers in the branches were definitely shorter than those in the stem.

An analysis of the data showed that the tracheids in the branches were significantly shorter than those in the adjacent stem in both the even-aged and uneven-aged series. The even-aged series of 48 samples had a "t" value of 7.50. The correlation coefficient was $r = 0.566$. Both of these statistics were highly significant. The regression equation was $Y = 0.7410 + 0.5676X$ in which Y is stem tracheid length.

Comparable results were obtained from the uneven-aged series of 48

THE AUTHOR is professor of silviculture, University of Georgia, Athens. Acknowledgment is made of the assistance of J. T. Greene and E. Carnes in collecting the data.

[1]University of Georgia, College of Agric. Expt. Sta. Journal Paper No. 67.

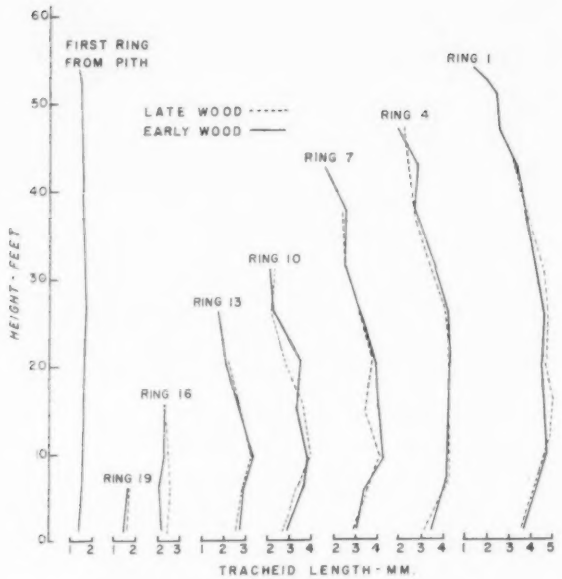

FIG. 1.—Tracheid length variation of springwood and summerwood tracheids in individual rings as related to age of annual increment and height in stem. (Tree No. 1.)

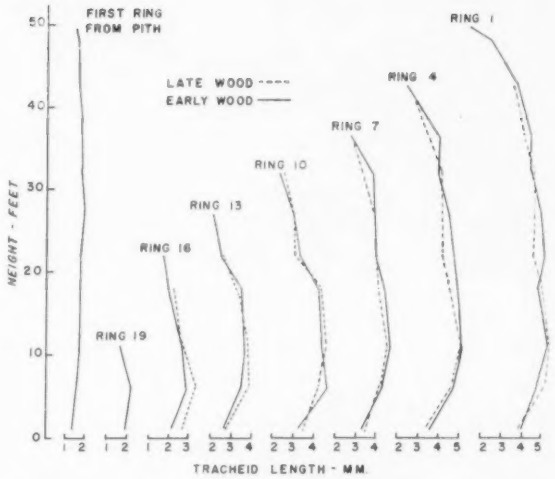

FIG. 2.—Tracheid length variation of springwood and summerwood tracheids within individual rings as related to age of annual increment and height in stem. (Tree No. 2.)

samples. The "t" value was 11.32 and the correlation coefficient was $r = 0.646$. Both values were highly significant. The regression equation was $Y = 0.6861 + 0.7347X$ in which Y represents the stem tracheid length. The difference between the two linear equations was not significant for either slope or means.

There was no significant difference between the linear regression equations computed for first ring tracheid length of the stem-branch combinations in the 1954 and 1955 whorls taken from 36 trees. The equations were $Y = 0.4810 + 0.8453X$ and $Y = 0.8706 + 0.6196X$, respectively.

These data have demonstrated that the length of the first-ring tracheids of the branch is highly related to that of the adjacent part of the stem. Thus, seedlings selected on the basis of long tracheids in the first ring of topmost branches will produce trees with long tracheids in the stem. Also, this short-cut method will permit the testing of inheritance of one of the important characteristics of wood quality by the progeny at a very early age. Furthermore, the progeny can be tested at periodic intervals without impairing the growth of the tree. This type of procedure should speed up investigations on the hereditary characteristics of certain anatomical features of wood quality.

Summary

Analyses were made of tracheid length variation in relation to position in stem and branches of loblolly pine.

At all heights in stem of two trees sampled, the length increased from the center outward through the 19th ring. In first ring from pith, the length increased slightly to a height of approximately 27 feet and then decreased to the top.

In each annual increment the length increased to a certain height and then decreased to the top. Length maxima occurred in the outermost ring.

Length of branch tracheids were highly correlated with those in the stem. Thus, the use of branches is feasible for evaluating the inheritance of tracheid length by the progeny.

There was no significant difference between average length of springwood and summerwood tracheids in each of the two trees sampled. Furthermore, the difference in length within each ring was not related to age of increment or height in the stem.

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Notes and Observations

Winter Sunscald of Yellow Birch

A recent examination of yellow birch stems in a fully stocked 30-year-old stand of northern hardwoods on the Upper Peninsula Experimental Forest near Dukes, Michigan, showed many of them developing serious losses in grade and volume as a result of old trunk injuries (Fig. 1). A similar type of injury was also noted on yellow birch saplings in the openings of a group selection cutting on an adjacent tract that has had three harvest cuts. In both stands the injuries were confined to the south and southwest sides of the boles. Although the damage closely resembled that caused by skidding, the consistent position of the injuries on the stems and their presence in the uncut second-growth stand suggested that an unusual climatic condition was probably the primary factor.

Winter sunscald of yellow birch, which is rare in the northern latitudes of its range, is considered the most probable cause. Although relatively unimportant at present, it may become increasingly evident

FIG. 1.—General view of 3 yellow birch trees in uncut 30-year old stand showing 10-year recovery from winter sunscald. Left, wound that is nearly healed over; middle, bark still intact over the scar; and right, a severe injury with stem partially broken off at 6 feet.

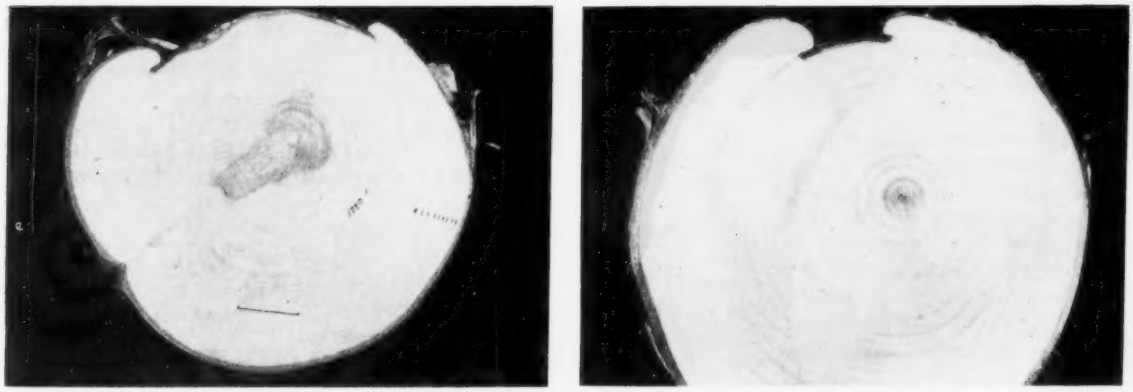

FIG. 2.—Cross sections of yellow birch stems at the widest portion of the injury showing callus growth over 1948 sunscald and development of decay during the 10-year interval since injury.

as thinnings and other stand improvement work are intensified. To aid in the identification of this type of injury and to determine its position and extent on the tree, several stems were sectioned and studied in the fall of 1957.

Type of Injury

A typically injured trunk showed callus tissue beginning near the root collar on the south or southwest side of the stem and ranging upward from 2 to 18 feet. The bottom of the injury showed a strong relationship to the snow depth.

Width of the injury between the callus growth was usually less than 0.5 foot. Between the callus tissue the wood was dead and in various stages of decay. On portions of the stem where the injury was narrow, the outer bark had remained intact, making detection difficult. The first outward appearance of callus tissue formation on the affected stems was noted in 1950.[1]

Yellow birch trees in the present stand range from 2 to 11 inches d.b.h. Of those injured, however, nearly all range from 3 to 6 inches. Although the uncut stand has 900 well distributed trees per acre and a basal area stocking of 105 square feet, the injured trees are still associated with narrow openings to the south or southwest. The size of this "opening" in the present stand is seldom more than 6 feet wide or 20 feet long.

[1]W. A. Salminen. Unpublished progress report, Lake States Forest Expt. Sta. 1950.

Probable Time of Occurrence

Sectioning of the stems at different heights showed that the injury occurred after the 1947 growing season was completed and before the 1948 growing season began. On all stems examined, the 1948 growth ring was narrow and merged with the previous year's ring back of the present callus tissue formation. The width of the callus growth was slightly greater on the west than on the east side of the injury. Discoloration showed only in the growth ring completed in 1947 (Fig. 2). Individual tree records did not show any significant effect of the injury on diameter or height growth for the 5-year remeasurement period.

Winter sunscald is believed to be caused by rapid freezing of tissues after they have been unseasonably warmed by the sun, usually in late winter (*1*). Climatic conditions during the fall of 1947 and through the spring of 1948 were generally unfavorable to conifers in the Upper Midwest because of abnormal temperature conditions (*3, 4*). Sunscald of planted yellow-poplar was reported during this period in southwestern Michigan (*2*).

Examination of U. S. Weather Bureau records for the Marquette, Michigan, station showed only one apparently extreme temperature change during the winter of 1947-48: On February 16 the air temperature rose rapidly from below freezing to a maximum of 51.1° F. at 3:30 p.m., and then dropped sharply to below freezing. The unseasonably warm temperature was accompanied by clear skies and a south wind reaching 12 m.p.h., the snow depth dropping nearly 5 inches during the day. Temperatures of other days in the month were near normal and seldom rose above 32°.

Considerations in Marking

As the primary cause of winter sunscald is exposure of the trunk, and smaller trees are generally more susceptible, the primary consideration in thinning and release work of young stands should be to leave "protection" trees on the south and west of yellow birch stems. Under the present utilization and economic conditions, however, most of the stand improvement work will be delayed until the stands reach at least the small pole size. At that time detection and removal of the severely injured trees will increase the quality and value of the final crop.

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Ohio Standard Saw Log Grades

There has been an increasing interest among both growers and buyers in Ohio towards the possibility of developing some form of standards for classifying sawlogs. The growers are interested in more information on log values, but price reports on log sales have no significance unless based on some accepted standard classification.

Log buyers have been using various methods of grading logs in Ohio and an increasing number have printed their price lists and specifications, but there has been no uniformity among them. Many buyers have said they would like some type of grading system, but felt that they lacked sufficient knowledge to prepare such a system themselves.

A conference of representatives of various public agencies in Ohio, including the Ohio Department of Natural Resources, U. S. Forest Service, Ohio Crop Reporting Service, Soil Conservation Service, Ohio State University (Agricultural Extension Service and Department of Agricultural Economies), Ohio Agricultural Experiment Station, Ohio Farm Bureau Federation, the farm editor of one of Ohio's leading farm radio stations, and the Ohio Forestry Association, Inc. expressed an interest in having a system of log grading development for Ohio and recommended that the Ohio Forestry Association prepare such a system if possible.

The OFA Forest Industries Committee, John Marsh, Jr., Marsh Lumber Company, Dover, Ohio, chairman, voted to study this proposal and a committee of timbermen was named to make this study and prepare a tentative sawlog grading system.

The committee of timbermen assisted by three foresters (one from Ohio Division of Forestry, one from U. S. Forest Service, and one private) reviewed several systems including the Purdue Saw Log Grades, U. S. Forest Products Laboratory Hardwood Log Grades, and several private Ohio industry systems and prepared a proposed system. This was reviewed by the OFA Forest Industries committee and the OFA Board of Trustees and approved. Copies were printed and presented by OFA at the Annual Convention January 23, 1959.

TABLE 1.—LOG GRADE SPECIFICATIONS FOR THE OHIO STANDARD LOG GRADES

	Minimum top diameter inside the bark	Other specifications
Prime logs	16″	Three poorest faces must be 90 percent clear and free from defects, in one cutting.
No. 1 logs	14″	Logs must be clear from 75 percent of the length on the three poorest faces, in one cutting.
No. 2 logs	12″	Logs must have at least 50 percent of the length on the three poorest faces clear in two cuttings neither of which is less than 3 feet long.
No. 3 logs	10″	Logs must be straight and sound with no heart defects.
Cull logs		Below No. 3 logs.

Since that time, Ohio's largest lumber manufacturer, D. B. Frampton Company, Columbus, has published a log price schedule, using the new Ohio Standard Saw Log Grades, and many other firms have indicated a willingness to do the same.

The system is similar in many respects to the Purdue Log Grades, with modifications that make it more suitable to Ohio conditions. The modifications are such that the yield of FAS and common lumber from each grade will not follow the results found by Purdue University so a new study will be needed.

The OFA has requested the Central States Forest Experiment Station to conduct a yield evaluation of these grades and the full cooperation of the industry has been assured.

Specifications are shown in Table 1.

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Incidence of Rot in Hardwood Sawtimber in Coastal North Carolina

Detailed scale records kept on compartments of experimental forests often yield associated information of considerable value. Data on the incidence of heart rot in mature loblolly pine were published[1] from scale records on the Bigwoods Experimental Forest.[2] Further examination of the scale books of four compartments from this experimental area shows the relative amount of defect caused by rot in hardwood sawtimber cut from an old-growth, unmanaged loblolly pine forest.

At the time of cutting, the dominant stand on these compartments was loblolly pine averaging over 100 years old. The hardwood sawtimber was of the same age and measured 10 to 24 inches d.b.h. Most of the hardwood trees cut for sawtimber were between 12 and 18 inches in diameter. Fire protection of the area has been unusually effective and fires have been rare in the last 40 years. On 148 acres the volume in sawtimber trees averaged 22,450 board feet (International ¼-inch) of pine and 1,840 board feet (International ¼-inch) of hardwood per acre. The number of

[1]Gruschow, G. F., and Trousdell, K. B. Incidence of heart rot in mature loblolly pine in coastal North Carolina. Jour. Forestry 56(3):220-221. 1958.

[2]Maintained by the Southeastern Forest Expt. Sta. in cooperation with Union Bag-Camp Paper Corporation, Franklin, Virginia.

hardwood sawtimber trees cut and scaled and the gross volume, together with the percent defect due to rot, are shown by species groups in Table 1. It is apparent that the amount of defect due to rot is much greater in the tupelos and maple than in the other hardwood species.

When these trees were logged, a system of tree grades was used to separate the trees into quality classes. The log scale, both gross and net, was kept by tree grade. These tree grades were established on the following basis:

Grade 1. Trees having at least 60 percent of the merchantable length clear of surface defect, and with no cull section of 10 feet or more in length.

Grade 2. Trees having from 40 percent to 60 percent of the merchantable sawlog length surface clear and with no cull section 10 feet or more in length.

Grade 3. Trees containing at least one sawlog with less than 40 percent of the merchantable sawlog length clear and with no cull section 10 feet or more in length.

Grade 4. Trees of sawtimber size containing more than 10 feet of cull section; or from which no sawlog can be obtained.

Table 2 shows the volume for hardwood species by tree grade with the percent of the volume defective due to rot alone. Again it can be seen that the tupelos and red maple have the highest percentage of volume in Grade 4 trees. The tree grading system takes into account such defects as sweep and crook; the scale figures used here show only the deductions due to butt rot or heart rot.

These data show the pattern of occurrence of defect due to rot in hardwood sawtimber in an unmanaged, old-growth loblolly pine stand which has been relatively free from fires. With a less favorable fire history the amount of cull in the hardwood sawtimber trees would have been much greater. If the stand had been under management, a high proportion of the cull trees and cull volume undoubtedly would have been removed or eliminated by cutting and cultural operations. Seventy percent of the total cull volume due to rot was in Grade 4 trees and an additional 20 percent was in Grade 3 trees. These trees would have been removed first under management. The data also illustrate that many hardwoods found in unmanaged pine forests cannot be considered as good growing stock.

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TABLE 1.—OCCURRENCE AND PROPORTION OF ROT IN THE HARDWOOD SAWTIMBER TREES

Species	Total trees	Trees with rot	Total volume	Volume deduction due to rot
	Number	*Percent*	*Bd. ft. (Int. ¼")*	*Percent*
Yellow-poplar	191	16	54,470	4
White oak	486	21	78,190	4
Other oak[1]	280	19	53,340	7
Sweetgum	402	13	51,965	5
Tupelos[2]	92	30	17,970	13
Red maple	223	57	16,490	38

[1]Other oaks include southern red oak, black oak, scarlet oak, water oak and willow oak.
[2]Includes black tupelo, swamp tupelo, and water tupelo.

TABLE 2.—GROSS VOLUME OF HARDWOOD AND PERCENT DEFECTIVE DUE TO ROT (BY TREE GRADE)

Species	Tree Grade 1		2		3		4	
	Gross volume	Amount deducted for rot	Gross volume	Amount deducted for rot	Gross volume	Amount deducted for rot	Gross volume	Amount deducted for rot
	Bd. ft. Int. ¼"	*Percent*	*Bd. ft. Int. ¼"*	*Percent*	*Bd. ft. Int. ¼"*	*Percent*	*Bd. ft. Int. ¼"*	*Percent*
Yellow-poplar	24,440	.5	15,285	1.1	12,195	3.0	2,490	61.4
White oak	9,205	.5	15,470	1.7	50,010	3.4	1,505	55.1
Other oak	12,240	.6	13,055	2.1	23,970	3.4	4,975	59.0
Sweetgum	11,745	1.1	11,940	1.2	22,755	1.6	5,525	36.3
Tupelos	9,560	1.8	1,905	3.9	2,200	2.7	4,305	47.3
Red maple	930	1.6	3,245	6.0	5,800	9.1	6,515	82.3

Epicormic Branching in Even-Aged, Undisturbed White Oak Stands[1]

Epicormic branches commonly develop on white oaks (*Quercus alba* L.) left following the harvest of dominant trees. As a result such residual stands show little promise of producing high-value trees. A recent study at the Amana Experimental Forest in Iowa shows that the number and location of epicormic branches on white oak trees are related to the crown class of the tree. Dominant trees in unthinned stands were found to have fewer epicormic branches than trees in any of the subdominant classes. The results from an earlier study in Iowa in heavily thinned oak stands were similar (*1*). In the light of the results from the present study, however, it appears that at least some of the epicormic branches occurred independently of thinning treatments.

Methods

One hundred white oak trees of each of four crown classes (dominant, codominant, intermediate, suppressed) were selected systematically in white oak stands approximately 95 years old. No cutting had been done in these stands for at least the past 20 years. Moreover, there was no evidence of cutting in the immediate vicinity of most of the sample trees during the entire period they had occupied the site. Crown closure was quite complete, but basal area per acre was somewhat below full stocking as defined by yield tables (*4*).

Records of epicormic branching were restricted generally to the lower 17 feet of tree stem because the quality of the wood above this point is generally lower and hence the presence of epicormic branches has little effect on grade in these upper logs.

Results

Number of epicormic branches per tree in the lower 17 feet varied from fewer than three on dominant trees to nearly ten on suppressed trees. Differences between codominant, intermediate, and suppressed trees, however, were slight (Fig. 1).

In addition to number, location of epicormic branches is also important. If all epicormic branches were located on one face of a factory-grade log, it would make little difference whether three or ten of them occurred—grade would not be affected.

Number of faces free of epicormic branches varied from almost three for dominant trees to less than one for suppressed trees (Fig. 2).

White oak logs need not be clear for a full 16-foot length to qualify for some high-value uses, such as veneer logs and stave or header bolts. Although the absence of epicormic branches does not ensure veneer-log quality (other defects are also important), the presence of many epicormic branches makes a log undesirable for face veneer and below the standards of most, if not all, factory-log grades.

The average height to the lowest epicormic branch varied from nearly 15 feet for trees of the dominant crown class to less than 8 feet for the suppressed class (Fig. 3).

In a similar study on yellow-poplar, Wahlenberg (*5*) suggested that epicormic branching in a closed stand will occur on the warmest face of the tree (usually the southwest face). But if a tree has an open face, most epicormic branches will occur on that one. Results from the present white oak study follow this pattern only in part.

There seems to be a slight tendency toward more frequent occurrence of epicormic branches on the southwest and southeast faces of white oak. However, the number of faces completely free of epicormic branches was only 6 percent

[1]Acknowledgement is due Gerald W. Anderson and Ronald Z. Whipkey research foresters, and Richard C. Plotz, forestry aid, for assistance in collecting the data on which this paper is based.

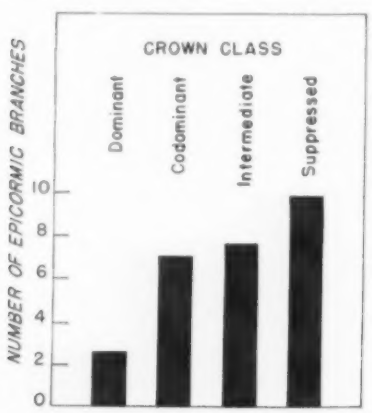

FIG. 1.—Average number of epicormic branches on the lower 17 feet of 95-year-old white oak in uncut stands, by crown class.

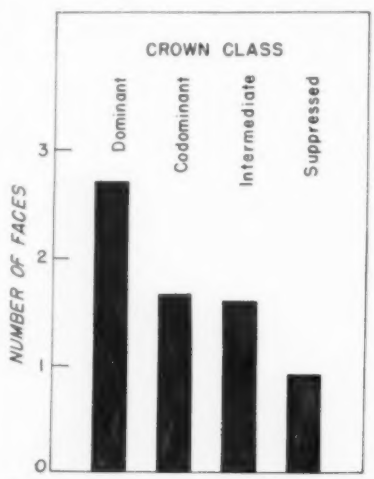

FIG. 2.—Average number of faces free of epicormic branches on the lower 17 feet of 95-year-old white oak in uncut stands, by crown class.

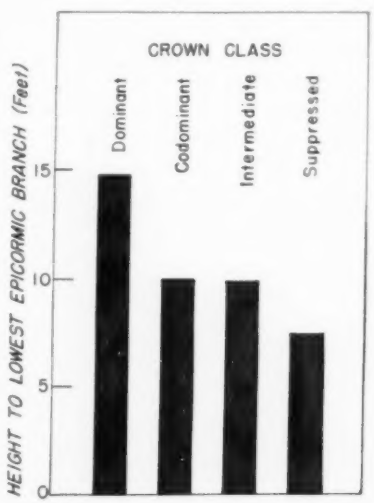

FIG. 3.—Average height to lowest epicormic branch on 95-year-old white oak in uncut stands, by crown class.

less on southeast and southwest faces than on the others.

On the other hand, the number of epicormic branches on the open face of 40 partially exposed trees was not significantly greater than on either the opposite or adjacent faces. The epicormic branches on the exposed face were longer, however, indicating that opening the canopy of a stand may be a greater stimulus to growth of already established branches than to formation of new ones. Because of the small sample, the results of this portion of the study should not be accepted as conclusive. However, it seems likely any real difference that may be determined from a larger sample of trees with exposed faces would be too small to be of economic importance.

Discussion and Conclusions

The superiority of white oaks of the dominant crown class in freedom from epicormic branches suggests the need for applying silvicultural systems that favor trees of that crown class to minimize de-grade caused by epicormic branching. Also the prolific branching on trees of the lower crown classes indicates that high-quality white oak cannot be grown in even-aged mixtures with the more rapidly growing black oaks.

It is not known if epicormic branches on oaks of the lower crown classes will disappear following release and subsequent crown closure, but observations made by the author and by others (*2, 3*) indicate that branches present at the time of release do persist. These branches develop until they appear to be a part of the normal crown. They are probably very effective in contributing to the overall food production of the crown, but equally effective in reducing the quality of the tree.

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A Further Test of Tree Bands for Cone Protection

A previous article by the author described a method for protecting ponderosa pine cones from cutting by tree-climbing squirrels.[1] One of the results from this study showed that banding isolated ponderosa pine seed trees with a sheet of 18-inch-wide, smooth aluminum prevented red squirrels (*Tamiasciurus hudsonicus richardsoni* Bachman) from climbing the trees and cutting cones and cone-bearing branches. Bands 12 inches wide or narrower were ineffective. At that time it was stated a trial would be made to test bands between 12 inches and 18 inches wide in an attempt to reduce banding costs. This note reports results of the followup trial.

During 1957 and 1958, bands 14 inches and 16 inches wide were tested on the same area in western Montana as in the previous experiment. The design was the same in that each size was replicated three times. Three unbanded trees and three trees having 18-inch-wide bands were used as controls. The upper edge of each band was 7 feet above ground line on the uphill side of the tree. As in the previous trial, the crowns of all test trees were at least 20 feet distant from crowns of adjacent trees.

During the 2-year period both the 14- and 16-inch-wide bands prevented tree climbing by squirrels. The 1957 ponderosa pine seed crop in the study area was rated fair and the 1958 crop good.

The two band width tests discussed here demonstrate that 14-inch-wide bands are the minimum size that can be used effectively.

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[1] Tackle, David. Protection of ponderosa pine cones from cutting by the red squirrel. Jour. Forestry 55:446-447. 1957.

Points of View

Comments on Professor W. H. Meyer's "Point of View" on Allowable Cut Calculations

Professor W. H. Meyer understandably felt compelled to defend his compound-interest calculation of allowable cut in the March 1959 JOURNAL OF FORESTRY.

I stated at the outset of my October 1958 JOURNAL article that any extrapolation (or projection) involves arbitrary or subjective decisions, and that the particular formula used is not too important. However, I also stated that simple interest allows better projection of stand volume than compound interest unless volume-growth is upward-cupped more of the time than it is downward-cupped or linear, and examination of almost any managed or unmanaged growth data will refute the upward-cupped hypothesis. The upward-cupped, drooping compound-interest curve will usually underestimate growth for periods shorter than the base period used to derive the compound rate, and will overestimate the growth for longer periods. This error may be trivial, as in the example worked out by Professor Meyer, but it may be considerably larger, and it becomes ridiculous if long-term projections are attempted, which Professor Meyer deplores but which economists sometimes insist on doing. Long-term simple-interest projections may not be realistic, but they are far less ridiculous than compound-interest projections.

By attacking one of my statements, he asserts that his compound-interest formula involves more than a 1-year projection, and that it explicitly provides for calculating allowable cut for periods longer than one year. Strictly speaking, this simply is not so. His formula requires taking a cut in the middle of *each year* of a period. Omitting $\left(1+\frac{g}{2}\right)$ allows taking the cut at the beginning of *each year* of the period, and additionally omitting the term $(1+g)$ from the denominator allows taking the cut at the end of *each year* of the period (for the convenient explicit form of his formula, see bottom of column 1, page 728, of the October 1958 JOURNAL OF FORESTRY). Taking n-times an *annual* cut is not the same as taking a single cut either at the beginning, middle, or end of the period. The simple-interest formula given at the beginning of my article *does* calculate a truly periodic cut, which is assumed to be mid-term as the formula is written, but which becomes beginning-of-term by omitting $\left(1+\frac{m}{2}G\right)$, and end-of-term by additionally omitting $(1+mG)$ from the denominator.

On page 936 of the December 1952 JOURNAL OF FORESTRY, Professor Meyer avers that regardless of how a forest grows, a strong argument for using compound-interest theory in growth prediction is that "the process of summation is greatly simplified by the use of the various rental or annuity formulas." Publication of my formula certainly removes that argument for use of compound interest, especially if one agrees that forests just do not follow an exponential curve for any considerable portion of their development. Each forester can now decide for himself about the relative simplicity of the two methods. Personally, I find that use of a desk calculator without log or interest tables is much simpler, quicker, and less subject to blunders than a number of table-look-ups and interpolations, along with some multiplication, division, addition, and subtraction.

To sum up, I do not share Professor Meyer's opinion that it is a tempest in a teapot to argue against an exponential projection if a linear projection is simpler and more realistic. Neither do I agree with him that my 4-page exposition of the desirability of simple-interest projection is excessive or misleading, when I consider his previous 12 or more JOURNAL pages advocating the use of compound interest without exploring alternative simple-interest techniques. I do agree with him that in many situations the numerical results obtained by the two formulae may not differ greatly, but I feel that even here the simple-interest formula is to be preferred because it assumes a model more consistent with biological behavior and because it is simpler to use.

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What Kind of Forestry Schools?

I should like to differ with Henry Clepper's emphasis in his "How Many More New Schools?" in the January JOURNAL OF FORESTRY.[1] Our problem seems to be not an excess of professional schools, but rather an almost total lack of them.

Let us consider forestry in terms of the five professional areas of the standard curriculum: silviculture, forest management, forest economics, forest protection, and forest utilization. Stop and think what a beginning competence in any one of these fields means in terms of basic sciences. Take just one—silviculture. This field cannot be approached in a professional manner without the background furnished by at least a semester course in each

[1]Clepper, Henry. How many more new schools? Jour. Forestry 57:25-28. 1959.

of the following: chemistry, physics, botany, plant physiology, genetics, plant anatomy, taxonomy, soils, meteorology, and ecology. Some schools may require this background. If they have smaller standards of preparation in the other four areas, the four years will be nicely filled out. But wait! Have we forgotten something? An education, perhaps? Wouldn't it be fine if our forester could read? Better still if he could write? Understand people, as well as trees? Understand society, as well as forests?

Let's tote up the bill. It looks like six years—perhaps seven. Well, do we want professional education or trade school training? The answer from the forestry schools is nearly unanimous: they want (or give) trade school training. Should we criticize the administrators of the new and would-be diploma mills, or should we ask the established schools why they haven't put themselves out of the class of the newcomers. Many of them have had lots of time.

This is unfair, or course. The schools don't operate in a vacuum. They need solid evidence of a demand for professionally educated foresters, and assurance that our profession will back them up in their programs. There is no doubt that the demand for professionally educated foresters exists—look at the statistics on numbers of degrees beyond the bachelor's. On the other hand, Henry Clepper is certainly right when he speaks of the ready market for inadequately educated foresters and of its depressing effect on salaries.

I believe that the market for inadequately educated foresters is evidence of a demand for men with ranger school training, and by this I do not mean to imply that there is anything inadequate about the latter. Much as I distrust analogies between forestry and medicine, may I suggest the gross waste we would commit if we delegated to physicians the whole job of caring for sick and guarding public health? Can we make serious claims to professional stature when "professional" foresters are employed for timber cruising, formen's jobs, policing campgrounds, and drafting, and kept at these jobs for years?

But, to return to professional education, I seem to have talked myself round to licensing. And why not? Is there any other way to keep the diploma mills from holding down the schools that could give a professional education if only we would help them? Membership grade sanctions within our Society should do some good, but it seems unlikely that anything short of employment sanctions will do the job.

There is no more important job than taking action, right now, to make professional forestry education a fact rather than a phrase. The fact that management of forestry lands, regardless of ownership, is becoming a reality on a large scale should not make us complacent about the good start we have made toward one of our principal goals. Much of the credit belongs to increasing demands for the products and values of forests. These demands, and the growing population which makes them, will require foresters much better educated than their predecessors. It is our obligation to see that these foresters are ready. We will not meet this obligation by merely increasing the numbers of schools of forestry.

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The Divergent Points of View of Forest Geneticists and of Agronomic and Horticultural Crop Breeders

The comments and quotations of Duffield and Snyder (*2*) suggest that the problems of hereditary forest improvement are so difficult and so different that little is to be learned from agronomic and horticultural crop breeding experience. This is a reflection of the very prevalent view of foresters that a forest geneticist must be first of all a forester, because the problems of hereditary forest improvement are basically forestry and therefore very different from those of agronomic and horticultural crop breeding.

Apparently forest tree breeding has developed independently. References to the genetics and breeding of non-forest species are uncommon in the literature of forestry. The importance of genetics is greatly subordinated to forestry in preparation for work as a forest geneticist or forest tree breeder, and plant breeding rates even less consideration.

I believe that such an attitude will seriously hinder and delay progress in forest tree breeding. The problems of hereditary forest improvement are essentially no different and no more complex than those for the breeding of agronomic and horticultural crops. Plant breeders believe that a competent plant breeder should be capable of planning and executing an efficient breeding program for any crop. Agronomic and horticultural plant breeders who are familiar with some of the tree breeding programs have serious doubts about their success because some of the basic principles have been overlooked.

Agronomic and horticultural crop breeding is older and more advanced than forest tree breeding. The emphasis in the training of agronomic and horticultural crop breeders is upon genetics and plant breeding with the biological and cultural characteristics of a particular crop having secondary consideration. Most students of plant breeding do not know which crop they will work on after completing their training. They assume that, whatever the crop, they usually will be associated with people who do know the biological and cultural characteristics of the particular species.

The basic principles of plant breeding and genetics have been found to apply to all species for which adequate studies have been made. Centuries would be required to verify with forest species the many experiments upon which our knowledge of genetics and plant breeding is based. The greatest returns for the time and money expended will be realized by accepting the basic information as true, even if it has not been discovered by foresters, and applying it for the hereditary improvement of forest species.

The basic principles of plant breeding and genetics are the same for all species, but the best methods of their application must, of course, be adapted to the biological and cultural characteristics of the species. The application of corn breeding methods in a cookbook manner for the breeding of alfalfa, for example, is impractical; but largely on the basis of research with corn, alfalfa breeders have developed methods of breeding that are adapted to the characteristics of alfalfa. Forest tree breeders cannot expect to apply successfully in a cookbook manner the adaptations of breeding methods used for the improvement of corn, forage crops, or any other crop. They must develop applications of the basic principles of plant breeding and genetics that are adapted to the characteristics of forest species, and a knowledge of agronomic and horticultural crop breeding will yield ideas that can be applied to the improvement of forest trees. When one considers the diversity of agronomic and horticultural crops, nearly all problems of forest tree breeders will be similar to ones that have been encountered previously in the breeding of some other crop.

The limited information of the genetics of forest species and the heritability of the characteristics of forest species is not a serious limitation upon the development of an efficient tree breeding program. Competent plant breeders are familiar with methods of estimating the mode of inheritance and the heritability of a character with sufficient accuracy for most of their needs without elaborate experiments designed for the specific purpose of acquiring such information. Very little is known about the genetics of such common domesticated crops as wheat, alfalfa, oats, and most of the horticultural crops, yet these crops have been improved efficiently without such information. A specific knowledge of the genetics of forest species is not essential for their improvement.

A comparison of the literature of forest genetics with that of the genetics and breeding of non-forest species indicates major differences in approach which, in my opinion, should not exist.

A large part of the literature of forest genetics is neither genetics nor plant breeding. For example, grafting (*8*) is plant propagation. Grafting may not merit a dominant role in the breeding and propagation of coniferous species because plant breeders may know more efficient ways of breeding and propagating the coniferous species without grafting. If grafting should be desirable, it may be more economical to hire a skilled horticultural nursery laborer to do the job. The vegetative propagation of ornamental clones of coniferous species is routine for horticultural nurserymen.

Forest geneticists are still concerned with the basic problems of genetics and plant breeding that were settled for agronomic and horticultural crop breeders years ago. For example, in reference to statements in the literature of forestry that are contrary to established principles of field plot design, Wright et al. (*11*) state, "We do not accept an author's word that a test site was so uniform that the difference must be due to genetic factors." The importance of soil heterogeneity in yield trials was demonstrated by the classic experiment of Harris (*5*).

Zobel et al. (*12*) and Goddard (*4*) imply that forest geneticists have the ability to recognize, on the basis of their appearance alone, trees that on the average will be outstanding parents for such characteristics as form and growth rate. A major part of the work on hereditary forest improvement is based upon this assumption, which is contradictory to the breeding experience with forest and non-forest crops. If the top 5 to 20 percent of the trees in a stand are selected for a seed production area without progeny testing, what is the evidence that on the average an improvement in the progeny from open pollinated seed in respect to form and growth rate could be realized by the removal of the unselected trees before pollination? What is the evidence that seed from an isolated clonal seed plantation or seed orchard established by the vegetative propagation of a limited number of the most outstanding trees on the basis of appearance will produce progeny that on the average will be better in respect to growth rate and form if progeny testing is not used as a basis for the selection? Could there be the slightest suspicion that the progeny from such a clonal plantation might be inferior? If the same standards were used for the selection of the seed trees before a logging operation, would seed from the felled seed trees be inferior?

The time and money involved in the efforts to produce hereditarily superior forest seed merit consideration of the literature that contradicts such an oversimplified method of tree breeding. Snyder and David (*9*) refer to the belief that like begets like as one of the oldest fallacies of heredity and one of the most difficult to eradicate. Sprague (*10*) states, "This method of breeding (mass selection) probably has been effective in modifying plant and ear type, maturity, and certain other characteristics, but has not been particularly effective in increasing yield during the past century." In reference to the judging of corn shows Hopt (*6*) writes, "[A] notice . . . should be placed in a prominent place over the corn show [reading] something like this: This is all a joke, folks. Don't take the thing too seriously. It should be distinctly understood by all visitors that this is just a little game we

boys have gotten up among ourselves. It has no relation to utility. Our prize-winning exhibits, upon which we so pride ourselves, mean nothing. They will not yield any more than other ears. . . ."

Garrison and Richey (*3*) state, "Without regard to reason, it is evident that close selection to any type, as practiced in these experiments, resulted in decreased productiveness." Boyce (*1*) states, "Dependence on a single resistant variety is highly hazardous." In reference to a one-parent progeny test of loblolly pine Minckler (*7*) states, "The analysis of the data showed no correlation between the juvenile height growth or survival of progenies and any observable characteristic of adult mother trees." In reference to growth rate on an apparently uniform site Wright et al. (*11*) state, "Red pine above one of these lenses grows significantly faster than does genetically similar stock a few feet away."

Foresters should decide whether the time and money for forest genetics is to be expended upon verifying with forest species information that is already confirmed in the field of plant genetics or upon the hereditary improvement of forest species. Forest geneticists need not repeat every mistake that has been made in the history of plant breeding. The opportunity to profit from the experience of agronomic and horticultural crop breeders is the greatest advantage of forest crop breeding.

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Medical Viewpoint Regarding Danger of Pine Pollen

Arthur H. Westing of the Yale School of Forestry has called to my attention his published note entitled "A Caution Regarding Pine Pollen."[1] Although Mr. Westing has accurately summarized our study of pine pollen, I do not believe that his suggestion that "It would perhaps be desirable to wear face masks during pine breeding operations" is justified on the basis of our present knowledge.

In the first place there is no absolute proof that pine pollen causes clinical sarcoidosis.

Secondly, on theoretical grounds the pine pollen is probably too large to reach the lung by way of inhalation.

Finally, the disease in question is relatively uncommon and I am certain that a large number of foresters and tree breeders would have developed the disease if it were transmitted by inhalation. Our epidemiologic studies suggest that this is not the case.

If pine pollen is capable of inducing clinical sarcoidosis, it selects only a small number of individuals who are unusually susceptible to the pollen and who probably get their exposure through other portals of entry.

In order to remove any concern or fear which might have resulted among forestry workers and tree breeders, I present this medical point of view.

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[1] Westing, Arthur H. A. caution regarding pine pollen. Jour. Forestry 57: 45-46. 1959.

Book Reviews

The Bobcat of North America

By Stanley P. Young. 193 pp. Illus. The Stackpole Company, Harrisburg, Pa. 1958. $7.50.

Publication of Stanley P. Young's fourth of a series of books on major predatory mammals, was preceded by three others for which Mr. Young served as senior author: *The Wolves of North America*; *The Puma, Mysterious American Cat*; and *The Clever Coyote*. The *Bobcat* book is without a co-author. Like its predecessors, publication of *The Bobcat of North America* was sponsored by the Wildlife Management Institute.

All of these books are monographic in scope. In mammalogical history no other writer appears to have concentrated to the same degree on four species or generic groups. Seton's monumental volumes are far more general, and the works of other mammalogists of multi-book fame are concerned primarily with taxonomy and distribution. Young's four books include taxomony, distribution, behavior and habits, economic importance, parasites and disease, control and, often, other topics. Indeed, the sub-titles of all—Part I of the first three—carry the words: ". . . History, Life Habits, Economic Status, and Control." Part II, in the first three volumes, is concerned with classification, for which Edward A. Goldman served in the Wolf and Puma books, and Hartley H. T. Jackson in the Coyote publication.

The Bobcat book follows the Young tradition in presentation: earthy, anecdotal, readable, with detailed treatment of areas in which the author has been personally concerned—hunting and trapping, field behavior, food habits, and economic importance. In the present work, the food habits discussion is largely from the unpublished work of C.C. Sperry ("The Food of the Bobcat," Fish and Wildlife Service), for which gracious acknowledgment is made (p. 71). This treatment provides the best published information the reviewer has seen on the kind and seasonal distribution of bobcat foods; it involves the analysis of 3,588 bobcat stomachs from 30 states, representing every month of the year. Among states with collections for each month are Arizona, California, Colorado, Michigan, New Mexico, Oregon, and Texas, giving good representation to the Southwest, where bobcat control in the interest of sheep and goat ranching has been most extensive.

Other than the chapter titled "Economic Status" in which food habits are included, the two most valuable chapters are "Habits and Characteristics" and "Hunting and Control." In the former, there is a great deal of natural history, much of which is presented as personal experience or the first-hand experiences of others. The chapter concerned with hunting (mainly trapping) and control is the best treatment of the subject the reviewer has seen. Young makes a strong case against bounty payments and the use of poison in bobcat control, the former because of the inevitable fraud, and the latter because of its ineffectiveness.

The bibliography, a notable feature of all the Young monographs, consists of approximately 750 titles and requires 45 pages, the longest section of the book. Little if anything of importance through 1954 was missed. Historical material is well represented.

The Bobcat of North America is, however, no profound scientific treatise—doubtless as the author intended. In fact, one is impressed by its simplicity. The treatment of bobcat predation per se is direct and country-wide, but there is little or no attempt to analyze this phenomenon from the standpoint of cause or effect. The killing of certain wild and domestic animals by bobcats is accepted and, indeed, documented; and recommendations for eliminating guilty 'cats are specific and forthright. The reader must refer to Errington, Latham, D. L. Allen, Grange, and others for insight on predation theory and consequence.

The book undoubtedly will become a guide for practitioners and a good general reference for students. Indeed, Young's conclusion specifically suggests this utility: ". . . this monograph . . . completes the author's attempt to bring together the pertinent natural history of, and economic role played by, our four main North American predators. It embodies most of my field experiences . . . with the predators for the past thirty-eight years of official life with the former Biological Survey and the present Fish and Wildlife Service.

"These four monographs are far from being the last work on the wolf, puma, coyote, and the bobcat, but they all, I hope, will be of some aid to our future workers who may be interested enough to take it from here. . . . May these animals never cease to have a place in our North American fauna, a condition that I am sure can be made possible on this continent . . . where their presence is not in conflict with human welfare. In other regions may they be tolerated in reasonably controlled numbers. To that end I have through these many past years given every support."

The taxonomic treatment, based on the work of Miller and Kellogg (U. S. Natl. Mus. Bull. 205, 1955) rather than on the more recent conclusions of various authors, will probably be disturbing to some. The type locality, synonymy, and geographic range are given for 11 subspecies.

Pleasing typography, d e s p i t e typographical e r r o r s, facilities

reading. The book is expensive for its size and makeup.

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Forestry in the Federal Republic of Germany

Revised by the Forestry Division of the Federal Ministry for Food, Agriculture and Forests. 55 pp. Illus. Bonn. 1958.

Written in the English language for foreign visitors to West Germany, this brief summary of essential information on the forests and forestry of that country is very concise, profusely illustrated with graphs and photographs, and remarkably informative.

Several points strike the American forester viewing German forestry through the pages of this booklet. First perhaps is the balance and distribution of the German forests which are fairly well distributed throughout the country; fairly evenly distributed in ownership between private forest, corporation forest, and state forest; and fairly evenly distributed in species and age classes between spruce and fir, beech, pine, and oak. The success of classical German forest management in achieving a balanced national economy is evident on every page.

At the same time, there are a few surprising points made, like the fact that 1,855 of the total of 2,226 technical foresters in Germany are in the employ of the various states, leaving only 111 employed on corporation forests and 260 on other private forests. Actual forest management in Germany is largely a public enterprise at the state rather than the federal level. About one-quarter of the forest area is not under management plan, but "consists of smaller holdings which are mostly managed intermittently." The farm forestry problem in Germany is evidently not much closer to solution than it is in this country.

The impact of World War II and the post-war occupation of Germany on the forests is made quite clear. As of 1949, about one million acres, or 6 percent of the total forest area, had been cleared. Under an intensive reforestation program, though, the clearcut acreage was reduced to less than two hundred thousand acres in 1957, about 1 percent of the total forest.

All phases of the forest economy are summarized, with valuable information being given on forest policy and legislation, management, silviculture, utilization, forest work, education, research, and multiple use management for game and forest production. Addresses of key forestry organizations and a list of important periodical publications in the field are also furnished.

The chief criticism of the booklet lies in the poor English in which it is written, compounded with the frequent poor choice of words and typographical errors. The best that can be said for it is that anyone fully understanding the text will have mastered a good bit of German sentence structure and grammatical usage in so doing. Notwithstanding, the work is an extraordinarily valuable and interesting source of information, one that the United States could well emulate by publishing similar summaries of American forestry in key foreign languages.

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Tree Maintenance

By P. P. Pirone. 3rd Ed. 483 pp. Illus. Oxford University Press, New York. 1959. $10.

Originally published in 1941 as *Maintenance of Shade and Ornamental Trees*, Pirone's book has been a basic one in its field for 20 years. This third edition has been completely rewritten and illustrated to bring it up to date with new material and recent developments. It is well illustrated with 19 line cuts and 130 half-tone plates.

The book is divided into two parts with the first one covering 144 pages in eight chapters on general maintenance practices. This section deals in detail with tree growth, soils, transplanting, fertilizers, pruning, wound treatment, bracing, and trees suitable for various locations.

The last section covering 277 pages in nine chapters deals with specific abnormalities of trees. It covers diagnosing tree troubles, nonparasitic injuries, insect control, spraying, and general parasitic diseases. The last three chapters deal with diseases and insects, based on the species of plants they attack, and divided into low growing trees tall growing trees, and evergreens.

The appendix is devoted to the 1957 National Shade Tree Conference and National Arborist Association Method of Evaluating Shade Trees.

The selected bibliography contains over 400 references to support and supplement the text.

This is a well written and illustrated book of great value to the home-owner and professional who deals with shade tree care.

KARL DRESSEL
Michigan State University

Publications of Interest

In a 32-page booklet published by Resources for the Future, Inc., Marion Clawson discusses *Methods of Measuring the Demand for and Value of Outdoor Recreation*. The material contained in the booklet was originally presented at a meeting of the Taylor-Hubbard Club at the University of Wisconsin, January 1959. Single copies are available without cost from Resources for the Future, Inc., 1145 Nineteenth Street, N. W., Washington 6, D. C. Additional copies may be purchased at a cost of 50c each.

* * *

Timber and Game-Twin Crops is a 32-page bulletin recently published by American Forest Products Industries, Inc., 1816 N St., NW, Washington 6, D. C. Written by Arthur H. Carhart for laymen conservationists and nature groups, and of interest to forest managers, the integration of wildlife crops and timber management is stressed.

Current Literature

Compiled by MARTHA MEELIG, *Librarian, State University College of Forestry at Syracuse University*
Range Management Section Compiled by NELLIE G. LARSON, *Library, U. S. Department of Agriculture*

General

The Ecology of Invasions by Animals and Plants. By C. S. Elton. 181 pp. Illus. Wiley, New York. 1959. $5.25.

A Guide to Field Laboratories of the California Forest and Range Experiment Station. Publ. as Supplement to the Annual Report. 1958. 46 pp. Illus.

The Manitou Experimental Forest—Its Work and Aims. By L. D. Love. 21 pp. Illus. Rocky Mt. Forest and Range Expt. Sta., Fort Collins, Colo. 1958. Sta. Paper No. 7 revised.

1001 *Questions Answered About Trees.* By Rutherford Platt. Dodd, Mead & Co., New York. April 1959. $6.

Forest Economics

Economics of American Forestry. By A. C. Worrell. 452 pp. Illus. Wiley, New York. Feb. 1959. $9.50.

Forest Resources

Forest Inventory Statistics for Beech River Watershed. 18 pp. TVA, Norris, Tenn. 1959. For. Bul. No. 64.

Forest Inventory Statistics for Dade County, Georgia. 18 pp. TVA, Norris, Tenn. 1959. For. Bul. No. 63.

Logging and Milling

Air-Drying Lumber to Increase Mill Profits. By R. A. Whitmore. 9 pp. Illus. Central States Forest Expt. Sta., Columbus 15, Ohio. 1958. Tech. Paper No. 158.

Log Grade Studies in the Ponderosa Pine Region; Lumber Grade Recovery from Douglas Fir, Western Larch, and White Fir at Halfway, Oregon. 24 pp. Forest Products Research Center, Corvallis, Ore. 1958. Bul. No. 7.

Pathology

Decay After Fire Injury to Southern Bottom-Land Hardwoods. By E. R. Toole. 25 pp. Illus. U. S. Dept. of Agric., Washington 25, D. C. 1959. Tech. Bul. No. 1189. 15 cents (Govt. Print. Off.)

Protection

Fire Fuels in Red Pine Plantations. By Loyd LaMois. 19 pp. Illus. Lake States Forest Expt. Sta., St. Paul, Minn. 1958. Sta. Paper No. 68.

Forest Fire: Control and Use. By K. P. Davis. 592 pp. McGraw Hill, New York. 1959. $12.

Range Management

Handbook of Colorado Native Grasses. By C. W. Herzman and others. 31 pp. Illus. Colorado Agric. Ext. Serv., Fort Collins. 1958. Bul. No. 450-A.

Hot Water Bath and Thiourea Break Dormancy of Wedgeleaf Ceanothus Seed. By R. L. Hubbard. 4 pp. California Forest & Range Expt. Sta., Berkeley. 1958. Res. Note No. 143.

1957 *Grassland Proceedings.* Annual Program of the Joint Committee on Grassland Farming, Stanford University, Aug. 29, 1957. 86 pp. Illus. Z. W. Craine, Secretary, Box 30, Norwich, N. Y.

Range-Pitting Trials in the Big Horn Mountains of Wyoming. By R. L. Lang. 8 pp. Illus. Wyoming Agric. Expt. Sta., Laramie. 1958. Bul. No. 357.

Range Robbers — Undesirable Range Plants. By W. A. Sawyer and others. 15 pp. Illus. Oregon Agric. Ext. Serv., Corvallis. 1958. Ext. Bul. No. 780.

Range Sheep Production. By Ivan Watson. 23 pp. Illus. New Mexico Agric. Ext. Serv., State University. 1958. Cir. No. 290.

Rest-Rotation Grazing—a Management System for Bunchgrass Ranges. By A. L. Hormany and A. B. Evanko. 11 pp. Illus. California Forest & Range Expt. Sta., Berkeley. 1958. Misc. Paper No. 27.

Silviculture

Bottomland Hardwoods Respond to Cutting. By L. S. Minckler. 10 pp. Illus. Central States Forest Expt. Sta., Columbus 15, Ohio. 1958. Tech. Paper No. 154.

Development of a Residual Stand of Interior Spruce-Alpine Fir During the First Twenty-Eight Years Following Cutting to a 12-Inch Diameter Limit. By R. F. Stettler. 15 pp. Illus. British Columbia Forest Serv., Victoria. 1958. For. Notes No. 34.

Influence of Slash Burning on Regeneration, Other Plant Cover, and Fire Hazard in the Douglas-Fir Region . . . By W. G. Morris. 49 pp. Illus. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. 1958. Research Paper No. 29.

Nine Years of Observations on the Condition of 241 Yellow Birch. By D. A. Fraser. Canada Dept. of Northern Affairs and Nat'l Resources, Forestry Branch, Forest Res. Div., Ottawa. 1959. Tech. Note No. 69.

Raising Forest Tree Seedlings at Home. By C. R. Ross. 10 pp. Illus. Oregon State College, Corvallis. 1958. Ext. Cir. No. 651.

Silvical Characteristics of Loblolly Pine. By K. F. Wenger. 32 pp. Illus. Southeastern Forest Expt. Sta., Asheville, N. C. 1958, Sta. Paper No. 98.

Study on Plane-Tree . . . in Iran. By Hejazi, R. and others. Summary in English. Illus. Univ. of Teheran Agric. College in coop. with U. S. Operation Mission to Iran, Karaj-Iran. Bul. No. 16.

Study on Softwood Trees in Iran. By Hejazi, R., Tabatabai, M. and Moslemi, A. A. Summary in English. Illus. Univ. of Teheran Agric. College in coop. with U. S. Operation Mission to Iran, Karaj-Iran. 1958. Bul. No. 15.

A Twenty Year Record of the Growth and Development of Indiana Woodlands. By Daniel Den Uyl. 52 pp. Illus. Purdue Univ. Agric. Expt. Sta., Lafayette, Ind. 1958. Research Bul. No. 661.

Soils

Forest Soils and Silviculture in Georgia. By L. C. Walker and H. F. Perkins. 36 pp. Illus. Georgia Forest Research Council, Univ. of Georgia, Athens. 1958. Rept. No. 4.

Wildlife Management

Deer Mouse and Reforestation in the Tillamook Burn. By Edward Hooven. 31 pp. Illus. Oregon Forest Lands Research Center, Corvallis. 1958. Research Note No. 37.

Trees and Game—Twin Crops. By A. H. Carhart. 32 pp. Illus. American Forest Products Industries, Washington 6 D. C. 1959.

Voles and Field Mice. By F. W. R. Brambell. 11 pp. Illus. Great Britain Forestry Commission, London, England. 1958. Leaflet No. 44. 1s. 0d.

Wood Technology and Utilization

The Physical and Mechanical Properties of Rewarewa . . . By J. M. Harris and C. R. Hellawell. 22 pp. Illus. New Zealand Forest Serv. For. Research Inst., Wellington. 1958. Tech. Paper No. 25.

A Review of the Literature on the Enzymatic Degradation of Cellulose and Wood. By E. B. Cowling. 26 pp. U. S. Forest Products Lab., Madison, Wis. 1958. Rept. No. 2116.

Shrinkage of New South Wales Timbers. By H. E. Booth. 23 pp. New South Wales Forestry Commission Div. of Wood Technology, Sydney. 1958. Bul. No. 3.

Survey of Wood Residue in Georgia. By R. H. Page and J. R. Saucier. 39 pp. Illus. Georgia Forest Research Council in coop. with Southeastern Forest Expt. Sta. and Georgia Forestry Commission. Dec. 1958.

Theories of the Combustion of Wood and Its Control; A Survey of the Literature. By F. L. Browne. 59 pp. U. S. Forest Products Laboratory, Madison, Wis. 1958. Rept. No. 2136.

Wood Waste Disposal and Utilization. By R. W. Boubel and others. 96 pp. Illus. Oregon State College Engineering Expt. Sta., Corvallis. 1958. Bul. No. 39.

Society Affairs

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1958-1959

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Council's Column

Should We Develop a Dual System of Forestry Education?

Does the present developing pattern of forestry practice and education promise to meet the needs of the future? Or will some sort of dual or multi-level system of education, subprofessional and professional, have to come if foresters are to consolidate their position in claiming to be true professionals? This is a central question to be appraised in the study of forest education now being conducted by the Society. It is a matter of deep concern to every member and each should make his views known.

Let me outline the problem through a series of propositions:

1. Much of the actual practice of forestry is semi-technical, a rather earthy job of executing many specific jobs, and does not require full professional training. A desirable ratio between subprofessional and truly professional workers depends on definition and circumstances but may well develop to be in the magnitude of perhaps four to one.

2. As the volume of forest practice develops, so does this ratio increase and consequently the need for subprofessional assistance. This applies to both administration and research.

3. So far, American forestry has not really felt the weight of this ratio as have countries with longer forestry history. Expansion in forest practice has, in general, opened up new jobs of professional level fast enough to give men of ability, initially often hired in essentially subprofessional capacities, opportunity to move on and up. This expansion will continue but a decreasing rate of establishment of professional-level jobs means that the forestry career-ladder employment pyramid will broaden proportionately as it enlarges. We are feeling the force of this now in some employment areas.

4. Establishment of a dual-level educational system in forestry—with a real career barrier in between—runs contrary to basic American educational and general philosophy. America is known as the land of opportunity; any boy can dream of becoming President and such dreams do come true, too. Nonetheless, the increasing technological and social complexity of professional fields is forcing more and more stratification, largely on a professional training basis.

5. The volume of strictly ranger school training has remained relatively small in the U. S. This is contrary to the situation in Canada and many other countries in which large scale ranger school training is well established.

6. There is substantial qualitative range in the character of forestry training now offered in the U. S., both accredited and non-accredited schools included. This range is wider than commonly realized and cannot be measured by analysis of curriculums. There are many reasons for this including the calibre of the parent institution, level of school financing, educational concept and policy, and the like. But the fact remains. The number of ranger schools by no means measures the gradient from largely vocational to top level education, including strong graduate work.

7. The present trend seems to be toward more schools, and particularly those primarily serving a particular area, than toward better schools. The

cost of good professional education is high and getting higher.

8. Professionalism in forestry, as in any field, is primarily established by the individuals who represent it. Forestry urgently needs professional men who are recognized as such by their colleagues in other fields. This can be achieved only by deeds, not chest thumping. Forestry as a whole cannot be professional in the same sense as law or medicine. There is too wide a range in the needed training and work of its practitioners. Forestry will never achieve very high professional status as long as goodly numbers of its representatives are not, to a discerning eye, professional men. Education is the basic key to development of professional status.

The above outlines some major facets of the problem. It is not new and in varying forms has been discussed since the beginning of U. S. forestry education. The last major round of discussion was about ten years ago (see SAF Proceedings for 1947 and 1948). But it does seem that recent rapid development, both in the practice of forestry and in expansion of educational facilities, necessitates reassessment of both the height and spacing of the educational goal posts.

How can we meet this problem within the general structure of our American democratic system? Following are some suggestions:

1. Establish higher qualitative as well as quantitative standards of professional forestry education. The Society has an inescapable obligation and major opportunity here through accreditation. Consideration must include graduate as well as undergraduate work.

2. Make a sharper distinction between some combination of essentially vocational-type training, often combined with one or more years of general college work, and professional forestry education. A desirable pattern would be to admit men to major professional training only after at least two years of good general college training including certain prescribed preparatory courses, plus six months or preferably a year of forestry experience. This experience would include summer camp and other vocational or semi-vocational training. This pattern could not be absolute, as men of ability should not be denied admission only because they have not had prior forestry experience, but this apprenticeship background is essential and the sooner it is started, the better.

3. Emphasize a fifth year of college, or essentially a third year of dominantly forestry work, normally leading to the master's degree, as needed for reasonably full professional preparation. Establish a secondary line of professional cleavage here.

4. As the demand supports, develop more ranger school type of training, if possible combined with two years of general college work to provide as many as possible with college experience. Recognize and develop jobs to fit such men and recognize it as an honorable calling. But, and here's the rub, also face up to recognition that this is not a direct channel to professional forestry.

Here is one suggestion, somewhat in the tradition of an old-world solution but with some American trimmings.

KENNETH P. DAVIS

❦❦❦

Fourth Call for Council Nominations

All members are hereby notified that the regular biennial election will be held December 5, 1959. A president, vice president, and nine other members of the Council will be elected for the two-year term 1960-1961.

The present Council is listed on page 381. Any or all of these incumbents may be renominated, provided they accept the nomination in writing.

Membership on the Council is restricted by the Constitution to Members (formerly Senior Members) and Fellows. Any Member or Fellow is eligible to hold office who is in good standing and who accepts the nomination in writing and declares his willingness to serve if elected.

Each voter will have an opportunity to ballot on all candidates for office. Council members are elected in accordance with the system of proportional representation. The procedure of proportional representation will be explained in a later issue of the JOURNAL. It is the system by which the Society has been electing Council members for more than two decades.

Table 1, page 136 February issue, shows distribution of Council members by states 1944-1959.

Candidates for the office of president are voted on separately; the candidate who receives the highest vote is declared elected president, and the candidate who receives the next highest vote is declared elected vice president. Thus all candidates for president are considered as nominated also for vice president.

How Nominations Are Made

The Constitution (Article VIII, Section 2) states the conditions under which nominations are made by petition.

1. Each petition shall name but one candidate.

2. All candidates must be eligible to hold elective office.

3. A petition shall bear the signatures of at least ten voting members who at the time of signing the petition are eligible to vote in the coming election. (Eligible voting members are Junior Members, Members, and Fellows in good standing.)

4. A voting member may not sign more than one nominating petition for president or more than one nominating petition for a member of the Council. That is, he may sign two, but no more.

5. Petitions must be in the Society office by September 19, 1959.

The Society has no special form for submitting nominating petitions. They may be written as follows:

We, the undersigned voting members of the Society of American Foresters, hereby nominate John Doe, a Member (or Fellow) for the office of president (or member of the Council) for the two-year term 1960-1961.

No nomination will be considered valid unless supported by the nominee's acceptance in writing.

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The form of acceptance of a nomination may read as follows:

"I accept the nomination to the office of President (or to membership on the Council) of the Society of American Foresters for the two-year term 1960-1961, and agree to serve if elected."

All nominating petitions should be sent promptly to the Society office, 425 Mills Building, Washington 6, D. C. The executive secretary will gladly provide information about nominating or election procedure.

According to the Constitution (Article VIII, Section 1) a Nominating Committee has been appointed by President Garratt. The Committee is composed of the following members:

Chairman, Harry Wm. Dengler, Extension Service, University of Maryland, College Park, Md.

Earl J. Adams, 4705 Tenth Avenue South, Minneapolis 7, Minn. (State Division of Forestry.)

Robert R. Milodragovich, U. S. Forest Service, Cody, Wyo.

Harry M. Roller, Jr., Woodlands Department, International Paper Company, Mobile 9, Ala.

George Stenzel, College of Forestry, University of Washington, Seattle 5, Wash.

This committee is charged with the following duties:

1. To set the date of the election. (December 5, 1959, is the date.)

2. To provide for at least two candidates for the office of president, and at least nine candidates for membership on the Council.

3. To receive separate nominating petitions for the office of president and for each member of the Council, and to supplement such petitions when necessary with other nominations in order to comply with item 2 above.

The Nominating Committee will make no nominations of its own unless the voting membership fails to make the required minimum number of nominations by petition. Voting members should accordingly get busy and make their own nominations.

Nominations Received

On the date of going to press the following nominations had been received:

For President

C. A. Connaughton, San Francisco, Calif. (Council member 1958-1959.)

Henry J. Malsberger, Atlanta, Ga. (Vice president 1958-1959.)

E. T. F. Wohlenberg, Ukiah, Calif.

For the Council

B. E. Allen, Savannah, Ga. (Council member 1956-1957 and 1958-1959.)

William C. Bramble, Lafayette, Ind.

Robert W. Cowlin, Portland, Ore.

Kenneth P. Davis, Ann Arbor, Mich. (Council member 1958-1959.)

George A. Garratt, New Haven, Conn. (President 1958-1959.)

W. D. Hagenstein, Portland, Ore. (Council member 1958-1959.)

Albert G. Hall, Washington, D. C.

Svend O. Heiberg, Syracuse, N. Y.

Robert N. Hoskins, Richmond, Va.

Horace R. Josephson, Washington, D. C.

Waller H. Reed, Chester, Calif.

Charles L. Tebbe, Missoula, Mont.

James K. Vessey, Atlanta, Ga.

John Zivnuska, Berkeley, Calif.

HARRY WM. DENGLER, *Chairman*
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Fourth Call for Fellow Nominations

All Members (formerly Senior Members) and Fellows of the Society are hereby advised that nominations for the grade of Fellow are now open. The election of Fellows will be held at the time of the Society's regular biennial election, December 5, 1959.

As defined by the Constitution (Article III, Section 7), "Fellows shall be foresters recognized generally throughout the profession as persons who have rendered outstanding service to forestry and to the Society. They shall be elected from the Members."

Nominations by Petition

The procedure for placing Members in nomination for the grade of Fellow is by petition. The Society has no printed form for this purpose; the petition may be typewritten thus:

We, the undersigned Members and Fellows of the Society of American Foresters, hereby nominate John Doe for election to the grade of Fellow in 1959.

Remember these simple rules:

"A splendid reference."
Hardy L. Shirley, *State University of New York*

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1. A petition may not name more than one candidate.

2. It must be signed by not less than 25 Members or Fellows in good standing.

3. It should be accompanied by a factual, not eulogistic, biographical sketch of at least 300 words giving an account of the nominee's professional career and accomplishments.

4. It must be received in the executive office of the Society in Washington, D. C., not later than September 19, 1959.

The executive employees of the Society cannot be responsible for obtaining signatures on partially completed petitions or on petitions incomplete by reason of unacceptable signatures (that is, signatures of other than Members and Fellows in good standing).

Election Procedure

Fellows are not elected by the membership at large, but by a board of electors which consists of all present Fellows, the Council, the chairmen of the 21 Sections, and the chairmen of the 9 subject Divisions.

The system is described in Article IV, Section 4 of the Constitution. To win election a nominee must receive an affirmative vote of not less than one-half the total number of votes cast, as provided in Bylaw 11.

For the 1959 election there will be 128 electors, of whom 88 are Fellows. An elector has one vote only. A Fellow who is also a Council member has but one vote.

Significance of the Grade

The highest membership distinction that can be conferred by the Society, this grade is awarded in recognition of outstanding service to forestry and to the Society. Fellows do not pay increased dues; their dues are the same as those of Members.

Since the Society was founded in 1900, there have been 125 Fellows elected. At the present time the number of living Fellows is 88.

Since the last election in December 1957, three Fellows have died: S. R. Gevorkiantz of Minnesota, J. S. Holmes of North Carolina, and F. W. Morrell of Virginia.

List of Fellows

The current roster of Fellows follows. The state in which each Fellow is domiciled and the year of his election are shown after his name.

Allen, Shirley W. Michigan. 1948.
Bailey, Reed W. Utah. 1955.
Baker, Frederick S. California. 1949.
Besley, Fred W. Maryland. 1940.
Boyce, John S. Connecticut. 1955.
Brundage, Frederick H. Oregon. 1949.
Butler, Ovid. Maryland. 1940.
Carter, E. E. District of Columbia. 1942.
Chapman, Herman H. Connecticut. 1922.
Clapp, E. H. District of Columbia, 1930.
Clepper, Henry. Virginia. 1949.
Coffman, John D. California. 1946.
Coulter, C. Huxley. Florida. 1957.
Cowan, Charles S. Washington. 1957.
Cox, William T. Minnesota. 1953.
Curran, Hugh. Venezuela. 1951.
Damtoft, W. J. North Carolina. 1951
Dana, Samuel T. Michigan. 1935.
Demeritt, Dwight B. Maine. 1955.
Demmon, E. L. North Carolina. 1951.
Detwiler, Samuel B. Colorado. 1955.
Drake, George L. Washington. 1953.
Dubuar, James F. New York. 1957.
Eldredge, Inman F. Louisiana. 1942.
Evans, Charles F. Georgia. 1949.
Evenden, J. C. Idaho. 1953.
Ferguson, J. A. Pennsylvania. 1949.
Fischer, Arthur F. California. 1940.
Fontanna, Stanley G. Michigan. 1955.
Frank, Bernard. Maryland. 1957.
Fritz, Emanuel. California. 1951.
Frothingham, E. H. California. 1942.
Garratt, George A. Connecticut. 1953.
Garrison, Paul M. Louisiana. 1957.
Gill, Tom. District of Columbia. 1948.
Granger, C. M. Maryland. 1946.
Guise, Cedric H. New York. 1951.
Guthrie, John D. Virginia. 1942.
Hall, J. Alfred. Wisconsin. 1955.
Hall, William L. Arkansas. 1940.
Hartley, Carl P. Maryland. 1949.
Hawes, Austin F. Connecticut. 1939.
Hawley, Ralph C. Connecticut. 1942.
Heacox, Edwin F. Washington. 1957.
Heiberg, Svend O. New York. 1957.
Heintzleman, B. Frank. Alaska. 1951.
Hosmer, Ralph S. New York. 1932.
Hunt, George M. Wisconsin. 1951.
Illick, Joseph S. New York. 1946.
Isaac, Leo A. Oregon. 1953.
Jeffers, Dwight S. Oregon. 1948.
Kaufert, Frank H. Minnesota. 1955.
Keen, Frederick P. California. 1955.
Kelley, E. W. California. 1949.
Kellogg, Royal S. Florida. 1949.
Kinney, Jay P. New York. 1942.
Kircher, Joseph C. Florida. 1957.
Kittredge, Joseph. California. 1953.
Korstian, C. F. North Carolina. 1942.
Krueger, Myron. California. 1951.
Lowdermilk, Walter C. California. 1948.
Lutz, Harold J. Connecticut. 1957.

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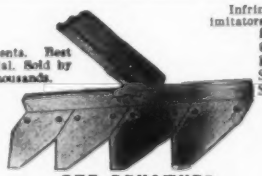

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Marckworth, G. D. Washington. 1955.
Marsh, R. E. District of Columbia. 1948.
Martin, Clyde S. Washington. 1948.
Mason, David T. Oregon. 1948.
McArdle, R. E. District of Columbia. 1953.
Merrill, Perry H. Vermont. 1957.
Metcalf, Woodbridge. California. 1953.
Munger, Thornton T. Oregon. 1946.
Munns, Edward N. California. 1949.
Nelson, DeWitt. California. 1957.
Porter, Earl. Alabama. 1957.
Preston, J. F. District of Columbia. 1948.
Price, Jay H. Arizona. 1951.
Reynolds, R. R. Arkansas. 1957.
Schmitz, Henry. Washington. 1940.
Shirley, Hardy L. New York. 1951.
Show, S. B. California. 1948.
Siecke, E. O. Texas. 1946.
Sparhawk, W. N. New Hampshire. 1946.
Wahlenberg, W. G. North Carolina. 1957.
Wakeley, Philip C. Louisiana. 1957.
Watts, Lyle F. Oregon. 1946.
Winslow, C. P. Dist. of Columbia. 1942.
Wirt, George H. Pennsylvania. 1948.
Ziegler, E. A. Pennsylvania. 1949.

Fellow Nominations

On the date of going to press the following Members had been nominated for the grade of Fellow:

N. T. Barron, Franklin, Va.

Clifford H. Foster, Warrensburg, N. Y.

Bishop F. Grant, Athens, Ga.

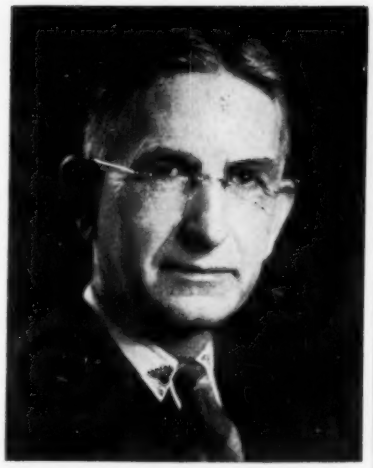
Harold G. Wilm, Albany, N. Y.

Ernest Wohletz, Moscow, Idaho.

S. T. Dana Named Director of SAF Education Study

Samuel T. Dana of Ann Arbor, Mich., dean emeritus of the University of Michigan School of Natural Resources, has been appointed as director of the Society of American Foresters' study of education in forestry and related fields of natural resources management. He will succeed Harold G. Wilm, who resigned as director in order to accept appointment as commissioner of the Department of Conservation in New York.

Launched last June, the nation-wide education study was made possible by a grant from the Old Dominion Foundation Inc., of New York City. The principal object is to set goals for professional and technical education in forestry and such related fields as forest-range management, forest recreation, forest-wildlife management, watershed management, and wood technology. All are offered as curriculums in the nation's 43 forestry schools.



SAMUEL T. DANA

Dean Dana, who will enter on the new asignment on a full-time basis next September, will have as his assistant Evert W. Johnson, who is currently at work on the study with headquarters at the College of Forestry, Syracuse, N. Y. Dr. Johnson is on leave from the School of Forestry at Alabama Polytechnic Institute.

In announcing the appointment, President George A. Garratt said that Dr. Dana will work with a supervisory committee of educators and foresters. The chairman is Henry J. Vaux, dean of the School of Forestry, University of California, Berkeley. Other members are:

Richard E. McArdle, chief of the Forest Service, U. S. Department of Agriculture, Washington, D. C.

Bernard L. Orell, vice-president of Weyerhaeuser Timber Company, Tacoma, Wash.

Hardy L. Shirley, dean of the College of Forestry, State University of New York, Syracuse.

Secretary, Henry Clepper, executive secretary of the Society of American Foresters, Washington, D. C.

President Garratt serves on the committee ex-officio.

A report on the findings of the study will be written by Dean Dana and Dr. Johnson and published by the Society as a book.

Members Organize Chapter in New England

On February 19 at the University of Massachusetts, Amherst, Mass., an organizational meeting was held wherein

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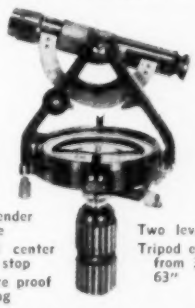

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the Yankee Chapter, New England Section, Society of American Foresters was formed.

About 80 Society members from Massachusetts, Rhode Island, and Connecticut petitioned to become members of the new Chapter.

Officers elected were: chairman, Robbert S. Bond, Department of Forestry & Wildlife Management, University of Massachusetts; vice chairman, William Reifsnyder, School of Forestry, Yale University; secretary-treasurer, Arthur G. Dodge, Jr., Rhode Island Forest Service.

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(As of April 24, 1959. Dates terms began are given)

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3. West Virginia

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2-6-59

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3. Enoree
4. Rappahannock
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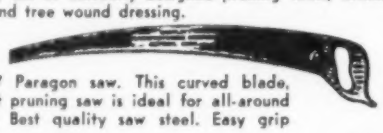

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11. Umpqua
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6. Northeastern Wisconsin

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatement received in the Society office during the month of March are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of June 1959.

Communications from the voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Ahrens, D. G., 1434 N.W. Third Ave., Gainesville, Fla. (Student 1956; Junior, **Southeastern**).

Alexander, W. M., Rt. 2, Mt. Gilead, N. C. (Student 1956, Junior, **Appalachian**).

Allen, R. S., Box 4214, State College, Raleigh, N. C. (Student 1957; Junior, **Appalachian**).

Anderson, H. L., 4832 28th Ave. S., Minneapolis, Minn. (Student 1956; Junior, **Upper Miss. Valley**).

Arbogast, K. A., 403 First St., Parsons, W. Va. (Student 1957; Junior, **Allegheny**).

Ashworth, J. T., R. R. #4, Nashville, Ind. (Student 1956; Junior, **Central States**).

Bahrman, R. G., Forester, American Box Board Co., Filer City, Mich. (Junior, **Wisconsin-Michigan**).

Baker, J. F., Dist. Supv., International Paper Co., West Point, Miss. (Junior 1954; Member, **Gulf States**).

Barres, C., Forester, Ministry of Agric., Santiago de Chile (**Corresponding**).

Bayless, J. M., 107 Third St., Morgantown, W. Va. (Student 1957; Junior, **Allegheny**).

Beaudoin, J. R., 12051 Aston St., Romulus, Mich. (Student 1956; Junior, **Wisconsin-Michigan**).

Beland, J. W. (Student, **Univ. Ga.**).

Bernhard, R. S., Forestry Asst., Hiwassee Land Co., Calhoun, Ga. (Affiliate, **Southeastern**).

Birtz, R. E., Supv., Osmose Wood Pres. Co., Manitowoc, Wis. (Junior, **Wisconsin-Michigan**).

Blaisdell, A. J., USFS, Quilcene, Wash. (Rein. Junior, **Puget Sound**).

Blalock, W. A., Forester, USFS, Pisgah Forest, N. C. (Junior, **Appalachian**).

Bowlin, H. L. (Student, **Pa. State**).

Bradbury, R. D., 333 Albert Ave., East Lansing, Mich. (Student 1956; Junior, **Wisconsin-Michigan**).

Branch, E. G., 2714 Boultier St., Montgomery, Ala. (Student 1956; Junior, **Southeastern**).

Brewer, W. P. (Student, **Univ. Ga.**).

Brogden, R. E., 206 West Glenn St., Auburn, Ala. (Student 1957; Junior, **Southeastern**).

Brown, H. D., Asst. Forest Supv., Union Bag-Camp Paper Corp., Townsend, Ga. (Junior 1955; Member, **Southeastern**).

Calhoun, J. C., Consulting Forester, Self-Employed, Gilsum, N. H. (Affiliate 1955; Junior, **New England**).

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Chauvey, D. A., R.F.D. #1, Old Town, Maine (Student 1958; Junior, **New England**).
Cheatham, N. H., 2501 Prince St., Berkeley, Calif. (Student 1956; Junior **Northern California**).
Chronic, R. W. (Student, **Univ. Idaho**).
Clarke, W. E., Forester, Va. Div. of Forestry, Charlottesville, Va. (Affiliate, **Appalachian**).
Cline, R. W. (Student, **Iowa State**).
Coggins, J. W. (Student, **Univ. Ga.**).
Colclough, D. M., Henniker, N. H. (Student 1957; Junior, **New England**).
Crary, L. R., Logging Foreman, Draper Corp., Tupper Lake, N. Y. (Affiliate, **New York**).

Dahl, P. N., Forester, Dierks Forests, Inc., Battiest, Okla. (Affiliate, **Ozark**).
Dallery, E. L., Proj. Forester, S. C. State Comm. of Forestry, Sumter, S. C. (Junior, **Appalachian**).
Davis, F. G., Forester, St. Regis Paper Co., Bryceville, Fla. (Junior, **Southeastern**).
Dolan, J. M. (Student, **Ore. State**).
Dubbels, L. G. (Student, **Univ. Idaho**).
Engle, C. H. (Student, **Pa. State**).

Epp, G. R. (Student, **Pa. State**).
Ewing, W., Purchasing Agent, Ore. State Board of Forestry, Salem, Ore. (Affiliate, **Columbia River**).

Faber, E. J., Dist. Forester, Wis. Cons. Dept., Marinette, Wis. (Rein. Junior **Wisconsin-Michigan**).
Fisher, H. E. (Student, **Univ. Minn.**).

Gaylord, T. E. (Student, **Univ. Ga.**).
Geoghegan, R. E., Logging Eng., Puget Sound Pulp & Tbr. Co., Seattle, Wash. (Junior 1952; Member, **Puget Sound**).
Grace, R. E., Forester, USFS, Haleyville, Ala. (Affiliate, **Southeastern**).
Grods, J. W., Forester, Quinault Ranger Sta., Quinault, Wash. (Affiliate, **Puget Sound**).

Halverson, S. D. (Student, **Univ. Minn.**).
Hammock, W. L. (Student, **Univ. Ga.**).
Hawthorne, D. R., Asst. Dist. Forester, Dierks Forests, Inc., Umpire, Ark. (Affiliate, **Ozark**).
Hoffman, R. D., 1124 Davis Dr., Lafayette, Ind. (Student 1957; Junior, **Central States**).
Hool, J. N. (Student, **Purdue Univ.**).
Hyndman, O. R., Asst. Dist. Forester, Battiest, Okla. (Affiliate, **Ozark**).

Illinick, R. H., Consulting Forester, Self-Employed, Littleton, N. H. (Junior 1952; Member, **New England**).

Jones, D. D., Asst. Dist. Forester, Dierks Forests, Inc., Hollis, Ark. (Affiliate, **Ozark**).
Jordan, T. E., 1004 Locust, Columbia, Mo. (Student 1956; Junior, **Ozark**).
Jourden, R. L., 215 Stafford Hall, Univ. of Mo., Columbia, Mo., (Student 1956; Junior, **Ozark**).

Kamin, W. F., Asst. Forester, Simpson Logging Co., Shelton, Wash. (Junior, **Puget Sound**).
Kelly, R. A. (Student, **Univ. Wash.**).
Khreishi, M. S., Forestry Asst., Ministry of Agric., Amman, Jordan (**Corresponding**).
Kintz, J. E., Service Forester, Pa. Dept. of Forests & Waters, Stroudsburg, Pa. (Junior, **Allegheny**).
Knaus, P. P., Asst. Ranger, Bonners Ferry Ranger Sta., Bonners Ferry, Idaho (Rein., Junior, **Inland Empire**).

Lantz, T. H., Parsons, W. Va. (Student 1958; Junior, **Allegheny**).
Lehrer, G. F. (Student, **Mich. Mining & Tech.**).
Loper, L. L., Forester, TC&I Div., U. S. Steel Corp., Fairfield, Ala. (Affiliate 1951; Junior, **Southeastern**).
Lopez, C. E., 2340 Piedmont Ave., Berkeley, Calif. (Student 1956; Junior, **Northern California**).
Lumpkin, J. C., Asst. Chief of Wood Procurement, Southland Paper Mills, Inc., Lufkin, Tex. (Affiliate 1955; Junior, **Gulf States**).
Lyle, R. F. (Student, **Pa. State**).

Maxey, W. R., Monteoal, W. Va., (Student 1958; Junior, **Allegheny**).
McDonald, F. W. (Student, **Pa. State**).
McDonald, J. B., 545 Panoromic, Berkeley, Calif. (Affiliate, **Northern California**).
McLean, M. D., Forester, International Paper Co., Ashland, Maine (Rein., Junior, **New England**).
Metcalf, G. E. (Student, **Univ. Ga.**).
Mills, I. D. (Student, **Univ. Fla.**).
Misura, A., Forest General Foreman, N. Y. State Cons. Dept., Lowville, N. Y. (Affiliate, **New York**).
Moyer, C. E. (Student, **W. Va. Univ.**).
Navratil, T. W., Asst. Ranger, Sandpoint Ranger Sta., Sandpoint, Idaho (Rein., Junior, **Inland Empire**).
Nelson, C. G., 1628 Lafond, St. Paul, Minn. (Student 1957; Junior, **Upper Miss. Valley**).
Olafson, F. A., Rt. #4, Aitkin, Minn. (Student 1956; Junior, **Upper Miss. Valley**).
Olson, D. L., 612 Lincoln Ave., Alameda, Calif. (Student 1956; Junior, **Northern California**)
O'Neill, R. S., Forester, Elliott Hardwood Co., Potsdam, N. Y. (Affiliate, **New York**).
Patric, E. F., Asst. Prof., Huntington Wildlife Forest, Newcomb, N. Y. (Junior, **New York**).
Patterson, B. E. (Student, **Univ. Ga.**).
Phelps, R. B., Grad. Student, School of Forestry, N. C. State College, Raleigh, N. C. (Junior 1952; Member, **Appalachian**).
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House, Berkeley, Calif. (Student 1956; Junior, **Northern California**).
Pinkard, J. J., Forester, U. S. Dept. of Agric., Baker, Ore. (Junior, **Columbia River**).

Raney, D. W., Grad. Student, State Univ. of N. Y., Syracuse, N. Y. (Rein., Junior, **New York**).
Roach, J. E., Lake Road Trailer Court, Gainesville, Fla. (Student 1956; Junior, **Southeastern**).
Rogers, J. P., 1123 S. W. First Ave., Gainesville, Fla. (Student 1956; Junior, **Southeastern**).
Rupp, C. M. (Student, **Pa. State**).

Seastrom, D. P., 723 N. Wash., DuQuoin, Ill. (Student 1956; Junior, **Central States**).
Seibert, L. M., Instrument Man, Willamette Valley Lbr. Co., Dallas, Ore. (Affiliate, **Columbia River**).
Selby, W. E., Range Mgmt. Asst., Okanegan Natl. Forest, Okanegan, Wash. (Junior, **Puget Sound**).
Smith, A. C., P. O. Box 157, Hazlehurst, Ga. (Rein., Junior, **Southeastern**).
Smith, G. T. (Student, **Pa. State**).
Spain, W. W., Forester, W. Va. Pulp & Paper Co., Summerville, S. C. (Rein., Member, **Appalachian**).
Stevens, G. J., Forester, Umatilla Indian Sub-Agency, Pendleton, Ore. (Rein., Junior, **Columbia River**).
Stilwell, C. E., Forester, Kaniksu Natl. Forest, Sandpoint, Idaho (Rein., Junior, **Inland Empire**).
Story, R. S., Forester, Minn. Forest Service, Red Wing, Minn. (Junior, **Upper Miss. Valley**).
Stroup, E. D., Forester, Jefferson Plywood Co., Madras, Ore. (Rein., Junior, **Columbia River**).
Stuelke, D. O. (Student, **Iowa State**).
Stump, R. F. (Student, **W. Va. Univ.**).
Switzer, C. F. (Student, **Ore. State**).

Therrien, E. N. (Student, **Univ. Minn.**).
Tilson, W. C., 236 Greenwich Rd., Lafayette, Ind. (Student 1957; Junior, **Central States**).
Toney, J. L., Box 8111, Univ. Sta., Baton Rouge, La. (Student 1952; Junior, **Gulf States**).

Ulrich, J. A., Dist. Ranger, USFS, Elk City, Idaho (Rein., Junior, **Inland Empire**).
Underhill, L. T., Forester, The Glatfelter Pulpwood Co., Fredericksburg, Va. (Junior, **Appalachian**).

Vaitkus, B. A., Forester, Bur. of Land Mgmt., Bemidji, Minn. (Junior, **Upper Miss. Valley**).
Vallelonga, J. F. (Student, **W. Va. Univ.**).
Voytas, F. J. (Student, **Pa. State**).

Wadsworth, J. B., Star Rt., White Springs, Fla. (Student 1958; Junior, **Southeastern**).
Weaver, H. E., Asst. Prof., Univ. of Ill. (Junior 1952; Member, **Central States**).
Weisgerber, J. F. (Student, **Ore. State**).
Williams, R. M. (Student, **Pa. State**).
Williams, R. M., Rt. 1, Logan, Ala. (Student 1957; Junior, **Southeastern**).
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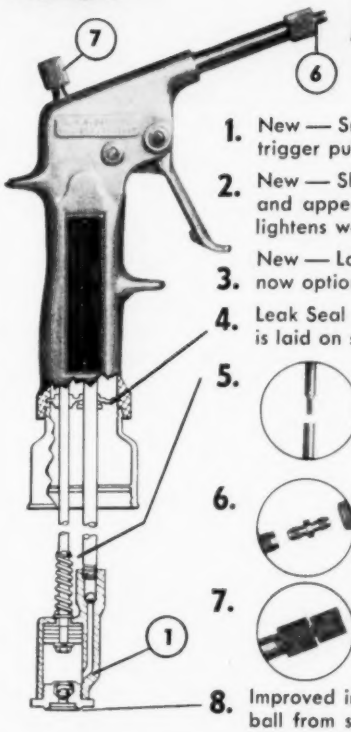

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Forestry News

PRINCIPAL SPEAKERS at a recent ceremony held at the University of British Columbia which marked the 150th anniversary of the founding of higher education in forestry in Hungary. *L.* to *R.* Harold S. Foley, Dean George F. Curtis, Dean George S. Allen, and Dean Kalmar J. Roller.

Hungarian Forestry School Marks 150th Anniversary

On March 19 at the University of British Columbia, Vancouver, the School of Forestry of Sopron University celebrated 150 years of forestry education and dedication to freedom.

Approximately 100 students, their professors, and 200 guests recalled together the history which brought the school to British Columbia in 1957. The tradition of Sopron Forestry School began 150 years ago at Selmec in what is now Czechoslovakia. Following World War I, the school moved *en masse* to Sopron, near the Hungarian-Austrian border. After the second world war and following 12 years under Communism, the Sopron faculty and students were active participants in the Hungarian revolution of October 1956. When, in November 1956, the Soviet army crushed the revolution and its hopes, Dean Kalman Roller led his staff and students to Austria. Soon afterward, through joint efforts of the Canadian government, the Powell River Company Ltd., and the University of British Columbia, the school was brought to Vancouver.

In 1958, 28 students received the B.S.F. degree (Sopron Division). Another 70 will graduate in 1959 and the two remaining classes, totalling 50 students, will graduate in 1960 and 1961.

Now far from their original Alma Mater, the student body and staff felt that the faculty in Vancouver had become the depository and beneficiary of their history and tradition and that the university should share its celebration. Memorial addresses were given by George F. Curtis, dean of the Faculty of Law; George S. Allen, dean of the Faculty of Forestry; Kalman J. Roller, dean of the Sopron Division of the Faculty of Forestry; and Harold S. Foley, chairman of the Board of Powell River Company.

An interesting and much more complete account of the heroic history of this group of Hungarian forestry students and staff was told by Robert Forbes and James B. Craig in the May 1957 issue of *American Forests*.

Soil Conservationists to Introduce 4-Cent Stamp

Postmaster General Arthur E. Summerfield recently announced that a soil conservation 4-cent postage stamp will be issued on August 26 at Rapid City, S. Dak. at the annual meeting of the Soil Conservation Society of America.

Ceremonies introducing the stamp will be a part of the opening session of the society's 14th annual meeting according to H. Wayne Pritchard, executive secretary of SCSA.

Use of Aerial Firefighting Cuts Size of Forest Fires

Because of increased use of aircraft in forest firefighting, the acreage burned on national forests dropped almost 15 percent in 1958 despite a 53 percent increase in the number of fires, the U. S. Department of Agriculture has reported.

Lightning and extended dry weather on the West Coast caused the number of forest fires on lands protected by the Forest Service to increase from 7,195 in 1957 to 11,050 in 1958. The area burned, however, dropped from 141,000 acres in 1957 to 120,000 in 1958. During the past five years the area burned averaged 244,125 acres.

The Forest Service assigns most of the credit for reducing the acreage burned to the improvement and increased use of aerial equipment developed during the past few years. Larger tanker planes were used last year for dropping fire retardents than heretofore.

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A cheaper fire retardent, bentonite, proved just as effective on an experimental basis as sodium calcium borate mixed with water which had been used exclusively until 1958. It is also lighter in weight, and thus more of it can be carried in tankers.

Use of aircraft has increased tremendously during the past five years. Aerial dropping of fire retardents was not used experimentally until 1956. In 1958 almost 1½ million gallons were dropped. This plus an increase in the use of smoke-jumpers more than doubled the flying time of planes from 9,703 hours in 1954 to 22,671 hours in 1958.

Helicopters, once used only for reconnaissance and occasional transportation of men, flew 3,746 hours in 1958 compared with 765 hours in 1954. They are now used to lay hose and spray fire retardents, as well as carry men and cargo.

Most of the aerial work is carried on by private individuals or firms. The Forest Service owns 32 airplanes and one helicopter.

Last year was one of the worst for lightning fires, with 6,828 reported on national forests. Only twice in the past 25 years have there been more lightning fires: in 1956 there were 7,669 and in 1940 there were 8,209.

Man-caused fires in 1958 did not quite reach the 1957 all time low of 3,269. Some 4,219 were reported on national forests. Man-caused fires, however, were below the 5-year average of 4,871, indicating that people are being more careful with fire in the woods.

Promoter of Canadian Forestry Dies

Gordon McGregor Sloan, former chief justice of British Columbia and timber adviser to the government of British Columbia, died suddenly January 14.

Justice Sloan did much in his lifetime to advance the forest industry in the province, a business with a value estimated now at $600,000,000 a year.

In 1945 as royal commissioner Justice Sloan developed the sustained yield foundation for British Columbia forests and the forest management licenses.

North American Wildlife Conference Held in New York

Ernest F. Swift, executive director of the National Wildlife Federation and an Associate Member of the Society of American Foresters, was awarded the Aldo Leopold medal for distinguished service to conservation at the dinner of the 24th North American

VICE PRESIDENT RICHARD NIXON inspects a model of the Oregon Forest Products Industry's proposed Centennial Pavilion. Explaining the pavilion's sweeping roof structure is its architect John Storrs of Portland (far left). Standing next to Storrs is Roy Gould, general chairman of the Oregon Forest Industries Centennial Committee.

Construction began in Portland, Ore., in February on the futuristic wood pavilion which will shelter 24,000 square feet of forest products displays at the Oregon Centennial Exposition and International Trade Fair—(June 10—Sept. 17).

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THE above display was one of a number of exhibits at Oregon State's Fernhopper Day, February 21. It is a graphic compilation made by undergraduate forestry students of all the materials necessary to complete four years of instruction. Textbooks, calked boots, tin hat (hidden), typewriter, transit, wood kit, and on and on. The students, in addition, made a calculation of costs—among them an item of $300 for coffee and doughnuts.

Wildlife Conference, in New York City, March 3.

About one thousand wildlife specialists, foresters, and other workers in natural resources attended the conference. Among SAF members participating on the program were William C. Bramble, Ralph T. King, and Henry Clepper.

Charles A. Dambach presided at a concurrent meeting of the Wildlife Society.

Representing the Republic of Mexico was Dr. Enrique Beltran, an Honorary SAF Member.

Tree Planting Doubles in Past Five Years

Tree planting has more than doubled during the past five years, hitting an all-time high of 1,568,708 acres during the fiscal year 1958, the U. S. Forest Service reports.

Of the record total, 1,534,264 acres were forest plantings and 34,444 acres windbarrier plantings.

This surpasses the fiscal year 1957 record of 1,170,990 acres, doubles the 1953 total of 715,548 acres, triples the 1950 plantings of 497,507 acres, and is more than 10 times the 138,970 acres planted in 1930.

State foresters with financial assistance from the Conservation Reserve of the Soil Bank have built additional nursery capacity to supply most of the trees needed by the Conservation Reserve tree planting program.

About 86 percent, or 1,326,370 acres, of last year's planting was on privately owned land. Florida led with 190,253 acres planted. Georgia was second with 186,588 acres. Mississippi and Alabama also broke the 100,000-acre mark.

Federal agencies planted 137,853 acres, an increase of 27 percent over 1957. About 89,000 acres planted were

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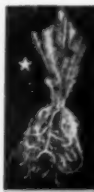

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national forests, and 28,000 acres were lands administered by the Department of Interior. State and other non-federal public agencies planted 74,534 acres, an increase of 15 percent.

A tremendous growth in direct sowing of tree seeds by hand and from the air was reported. Last year 81,296 acres were sowed as compared to 32,693 acres in 1957.

Private & Industrial

Amidon Reelected President of APA

George Amidon was reelected to the position of president of the American Pulpwood Association at a meeting of the Board of Directors on February 24, according to an announcement by W. S. Bromley, executive secretary of the Association.

Mr. Amidon is the 11th president of the American Pulpwood Association since its formation in 1934. He has been director of woodlands for the Minnesota & Ontario Paper Co. since 1956.

The following members of the Board were elected vice presidents of the Association: (1) A. G. Curtis, Gaylord Container Corporation, Division of Crown Zellerbach Corporation, Bogalusa, Louisiana; (2) D. E. Hess, Glatfelter Pulp Wood Company, Gettysburg, Pennsylvania and, (3) L. J. Kugelman, International Paper Company, New York City.

Killian Directs Vermont Foundation

Edgar W. Killian has been appointed executive director of the Vermont Forest and Farmland Foundation succeeding William H. Meyer, who was elected U. S. Congressman last fall.

Foundation trustees also announced plans for a long-range operating program for the 2600-acre area, created by the late George W. Merck of Rupert and West Orange, N. J.

Killian, who graduated in forestry from Michigan State University in 1937, was resident manager of Glastenbury Timberlands near Bennington from 1954-58. Prior to that time he had been resident manager of the Draper Corporation woodlands, Woodford, Vt., for 11 years.

He has served on the management committee of the S.A.F. New England Section since 1957 and as chairman of the Green Mountain chapter since 1958. He is a director of the Associated Industries of Vermont and the Northeast Loggers Association.

The late Mr. Merck established the Vermont Forest and Farmland Foundation in 1950 with three basic objectives: to conduct research and experiments to help improve Vermont forests and farmlands; to make results of these experiments available to its Vermont neighbors and other interested persons; and to cooperate with local, state, national, and private organizations doing similar work. Francis W. Hatch, Jr., is president of the Foundation.

St. Regis Appoints Northwest Assistant Forestry Director

St. Regis Paper Company has announced that Robert DeLong was in March appointed assistant to Paul M. Dunn, director of forestry, to serve as liaison and to coordinate activities with federal, state, and private forestry groups in the Pacific Northwest.

Mr. DeLong, whose appointment became effective April 1st, has been associated with St. Regis in the Northwest since November, 1944, and has been assistant general manager of logging and assistant to the logging manager. He will continue to make his headquarters at Tacoma, Washington.

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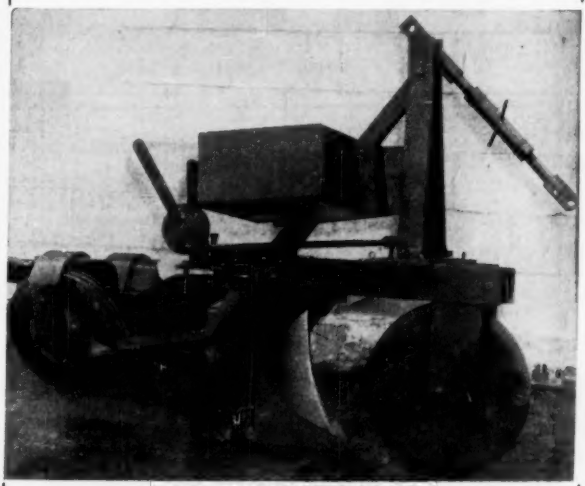

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Three Promoted At Owens-Illinois

New wood procurement managers have been named at three pulp and paper mills of the Mill Division of Owens-Illinois Glass Company by C. G. McLaren, vice president and general manager.

Those promoted include Walter L. Crown, Jr. at Valdosta, Ga., Erith L. Hopp at Jacksonville, Fla., and David L. Buell at Big Island, Va. Crown and Hopp will work with G. H. Wesley, manager of the Southern Woodlands, and Buell will report to J. W. Haley, recently appointed general manager of woodlands.

Crown joined the company after receiving his bachelor's degree in forestry in 1952 from the University of Florida and has served in Valdosta as assistant wood procurement manager for the past five years.

Hopp, a graduate in forestry from Iowa State College, has served at Owens-Illinois mills in Wisconsin and Michigan and, for the past year, in the company's general offices in Toledo, Ohio.

Buell joined Owens-Illinois a year ago at the Big Island mill after 12 years of experience in forestry. He has a master's degree in forestry from the University of Michigan.

Crown Zellerbach Foresters Advance

Crown Zellerbach's Northwest timber department headquarters has announced six promotions at the company's Cathlamet and Clatsop logging divisions.

V. Y. Davis, formerly Clatsop resident engineer, has been promoted to the position of assistant logging superintendent for the Seaside, Ore. based operations. C. L. Wood, Clatsop resident forester, will assume the duties of resident engineer and will head the division's forestry and engineering departments as resident forest engineer.

M. A. Mosar, who was Cathlamet resident forester, has been promoted to the assistant superintendent position at the southwest Washington logging division. D. L. Burdick, Cathlamet resident engineer, becomes resident forest engineer. W. S. Hicks, Cathlamet forester-fire warden, has been named assistant resident forest engineer. F. G. Edmonson, Cathlamet dispatcher, takes over the fire warden duties for Crown Zellerbach's Wahkiakum and Pacific county lands.

Intermountain Logging Conference Held

Donald E. Colwell of Yakima, Wash., was elected president of the Intermountain Logging Conference on the occasion of that organization's 21st annual session at Spokane, Wash., March 22-25.

Colwell is logging manager of the Cascade Lumber Co. of Yakima. The Cascade operation, as the result of a merger about two years ago, is now part of the Boise-Cascade Corp. Colwell was graduated from the University of Washington School of Forestry in 1934.

The Intermountain Logging Conference provides an annual clearing house of ideas for foresters, loggers, timberland owners, and others in eastern Washington and Oregon, Idaho, Montana, and parts of British Columbia. The three-day 1959 meeting drew a registration of more 1,100 men and some 300 women.

Held simultaneously at Spokane in conjunction with the Logging Conference was the Fourth Logging Equipment Show. Some 60 machinery suppliers participated and put on display a wide variety of equipment having an estimated value of several million dollars.

St. Regis Awards Two Fellowships

In recognition of the increasing interest and activity in the fields of scientific forestry and forest genetics, as well as its own expansion in the forestry field, St. Regis Paper Co. has made available an additional Fellowship in Forestry. Now St. Regis offers two fellowships, valued at $1,000 each, and given for one year. St. Regis has awarded one such Fellowship annually for the past six years to degree holders planning to take graduate work in any accredited school of forestry in the United States or Canada. Also, for the seventh year, St. Regis offers five undergraduate scholarships in forestry.

Winners of the two St. Regis Fellowships in Forestry this year are Russell J. Hutnik of State College, Pa., and John P. Vimmerstedt of Asheville, N. C.

Hutnik holds a B.S. degree in Forestry from Pennsylvania State University and a Master's degree from Yale. At present, he is an assistant professor at the School of Forestry at Penn State. He had served as research forester with the Northeastern Forest Experiment Stations and is the author of a number of publications in the forestry field.

Vimmerstedt is currently a research forester with the Southeastern Forest Experiment Station. He has a B.S. in forestry from the New York College of Forestry, and a Master's degree from Yale.

Western Association to Offer Forestry Consulting Services

Engineering and Marketing Associates, Inc., an organization devoted to offering the services of consultants for industrial and business research and development, with headquarters in Portland, Ore., has recently announced the addition to its association of a Timber Products Management Group.

Ten staff consultants in the group will offer counselling and services in the fields of timber acquisition and management, logging operations, converting operations, administration, and international fields.

In selecting the group an attempt was made to compose a staff which would represent experience in operating background covering the region of the 11 western states and all the major species of timber grown there. SAF members who have been appointed consultants are George L. Drake, Edward Hanzlik, and Clyde Martin.

Crown Zellerbach Reports 1958 Hunter's Harvest

About 17,000 Oregon and Washington sportsmen hunted big game on Crown Zellerbach Corp.'s 12 Northwest tree farms during the 1958 hunting season. Their total bag was 2,214 big game animals, including 1,495 deer, 531 elk, 155 bear, 11 bobcats, and 22 coyotes.

All of the company's tree farms were open to hunters and fishermen last year, continuing the company's long established policy of recreational use of its lands.

Several areas were open during the entire week but on others hunting was allowed only on weekends where logging operations were underway. Two Oregon tree farms, the Clackamas Tree

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F. L. MORAVETS

Farm and the Wilson River tract of the Tillamook Tree Farm, were closed for a short time during the hunting season when critical fire conditions prevailed but were re-opened when weather conditions became less hazardous.

The deer kill was down slightly from 1957's 1,609 but the elk bag was upped by 31 from the previous year's total of 500.

George H. Schroeder, Crown Zellerbach chief forester, commended the sportsmen for their cooperation during the serious fall dry spell. "The vast majority of sportsmen made every effort to observe our fire prevention suggestions," Schroeder said. "As a result, there were only three hunter-caused fires on our lands despite the fact that fire danger in 1958 was the highest in years."

Schools

Dr. Ranby Appointed to Syracuse Post

Bengt G. Rånby has been appointed as the Director of the Empire State Paper Research Institute and as professor of Pulp and Paper Technology at the State University College of Forestry at Syracuse University (Syracuse, N. Y.), effective April 1, according to Dr. Hardy L. Shirley, dean of the College.

Dr. Rånby, when appointed, was research specialist and group leader with the American Viscose Corp., at Marcus Hook, Pa.

The Empire State Paper Research Institute is jointly supported by the College of Forestry and the Empire State Paper Research Associates, Inc., a non-profit organization comprised of pulp and paper companies in the United States, Canada, and Europe. ESPRA was incorporated in 1945 for the purpose of supporting pulp and paper research. The main efforts of the college's research group have been directly concerned with improved pulps from hardwoods.

Born and educated in Sweden, Dr. Rånby received his undergraduate and graduate degrees from Uppsala University (Sweden). While at Uppsala, he was research assistant to Nobel prize winner Prof. The Svedberg, and later was appointed assistant professor of Physical Chemistry. During 1952-1953, he was a duPont Research Fellow in polymer chemistry at the Brooklyn Polytechnic Institute.

Warner New Member Clemson Forestry Faculty

John Robinson Warner has been appointed as associate professor in the Department of Forestry of Clemson College, the land-grant institution of South Carolina. He will lecture in forest economics and related subjects.

Dr. Warner pursued his academic work at Duke University where he was granted the B.S., M.F., and D.F. degrees in 1946, 1949, and 1953 respectively. He served as instructor in forestry at both the School of Natural Resources at the University of Michigan and the Division of Forestry, University of West Virginia. Prior to his present position at Clemson, he was forest economist on the staff of the Lake States Forest Experiment Station.

Clemson's Department of Forestry, of which Dr. Koloman Lehotsky is the head, now has a faculty composed of five members lecturing in various specialized disciplines. These members are: Professors M. H. Bruner, M.F.; B. M. Cool, Ph.D.; K. Lehotsky, Ph.D.; R. D. Shipman, Ph.D.; and J. R. Warner, D.F.

Public

F. L. Moravets Retires

Retirement of Floyd L. Moravets, chief of forest economics research at the Pacific Northwest Forest Experiment Station, has been announced by R. W. Cowlin, station director.

Moravets left federal service March 31 after 34 years devoted to forestry administration and research in Oregon and Washington.

He began his career in public forestry in 1922 when he accepted a posi-

tion with the Portland regional office of the Forest Service. Until 1924, and again in 1928, he was engaged in timber resource inventories on several national forests in Oregon and Washington. He was privately employed for 3½ years in the mid-1920's.

In 1929 he joined the staff of the experiment station, where for the next 17 years he participated in and then directed the station's forest resource survey work.

From 1946 to 1957, Moravets specialized in analysis of survey data and results of economic studies relating to forest resources and their utilization, earning a meritorious award for superior accomplishment from the chief of the Forest Service in 1953. In 1957, Moravets was promoted to head the Forest Economics Research Division.

During his years with the experiment station, Moravets has written more than 50 publications about Pacific Northwest timberland resources. A native of Iowa, he is a 1922 graduate of Iowa State College. He served in the artillery in World War I.

T. C. Nelson Returns To Federal Service

Thomas C. Nelson, after a two-year absence with private industry, has returned to the Southeastern Forest Experiment Station in Asheville, N. C., as assistant chief with the Division of Forest Management Research. Nelson will have primary responsibility for the station's program of pine management.

Nelson holds degrees from the University of Wisconsin and Michigan State University. Prior to his first employment by the Southeastern Station, he served as a communications officer with the U. S. Navy, and also held the post of biologist in charge of the Cusino Wildlife Experiment Station in Michigan.

In 1950 he joined the Southeastern Station as a research forester on the Hitchiti Experimental Forest. He later served as silviculturist at the Coweeta Hydrologic Laboratory and project leader for the Hardwood Management Project at the Athens-Macon Research Center. In 1957 he joined the Kirby Lumber Corporation in Houston, Tex., as administrative forester in charge of forest management.

Nelson is a member of Xi Sigma Pi and Sigma Xi. In 1956 he received a Certificate of Merit from the U. S. Department of Agriculture for the development of a well-rounded program of hardwood management research in the Piedmont.

Boyd L. Rasmussen

Ogden Forester Promoted To Washington, D. C. Office

Boyd L. Rasmussen, assistant regional forester with the U. S. Forest Service at Ogden, Utah, accepted an appointment, effective April 13, as deputy assistant chief on the staff of the chief of the Forest Service in Washington, D. C., according to Floyd Iverson, regional forester.

Mr. Rasmussen has been chief of the Intermountain Regional Division of Fire Control and State and Private Forestry since 1954.

Before going to Ogden in 1954, he served as assistant chief of fire control for the Forest Service in Washington, D. C. Prior to this, he served in the Pacific Northwest as forest supervisor of the Siuslaw National Forest.

Mr. Rasmussen entered the Forest Service after graduation from Oregon State College in 1935.

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Routt Forest Supervisor Named

John C. Miller, recreation project inspector, Branch of Recreation and Land Uses, for the Rocky Mountain Region of the Forest Service is being promoted and transferred to supervisor of the Routt National Forest in Steamboat Springs, Colo. Mr. Miller will fill the vacancy resulting from Supervisor Robert Gardner's transfer to the Regional Office in Denver.

Regional Forester Donald E. Clark made the announcement stating that the transfer was effective about April 1.

Mr. Miller received his forestry degree from Pennsylvania State University in 1934. Prior to his present assignment, he served as staff officer on the Gunnison National Forest, district ranger on the Grand Mesa, Medicine Bow, and Routt Forests and filled short assignments on the Roosevelt Forest.

Supervisorship Changes At Shoshone

Irvin P. Murray, supervisor of the Shoshone National Forest, with headquarters at Cody, Wyo., is being assigned to the staff of the regional forester, Southwestern Region, in Albuquerque, N. Mex. Regional Forester Donald E. Clark announced that the transfer was effective March 23.

Murray transferred to the Shoshone from the Intermountain Region, Ogden, Utah, in October 1956.

Roderick K. Blacker, who will succeed Murray at Cody, received a B.S. degree in forestry at Oregon State in 1938. For the past several years he has headed up the Branch of Range Management in the Division of Range and Wildlife Management in the Rocky Mountain Regional Office at Denver. He has served as ranger, forest staff assistant, and in various other positions in Colorado, South Dakota, and Oregon during his career.

Elmer R. Roth is Transferred

Elmer R. Roth, plant pathologist with the Southeastern Forest Experiment Station, is being transferred to Atlanta, Ga., to serve as staff assistant in the pest control section of Region 8, U. S. Forest Service. In his new position, Mr. Roth will serve as a specialist in the control of forest diseases.

A graduate of the University of West Virginia, Roth entered federal service in 1934 and served with the Division of Forest Pathology of the Bureau of Plant Industry until it was incorporated into the Forest Service in 1954.

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Positions Wanted

Forester, B.S., 1950, Washington State; M.F., 1951, Duke. Age 34. Desires teaching or extension work. Presently serving as replacement for professor on leave. Nine years experience, including five years teaching. Specialized education in forest entomology, but with experience in several other phases of forestry including employment in federal and private industry.

Box I, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S.F., 1952, Univ. of Mich. Age 33, married, 3 daughters. 10 years varied experience with an industrial association, including reforestation, pasture establishment, grading, forest management, protection, public relations, flying, photography, (aerial press), photo interpretation, surveying, drafting, instruction at youth camps, wildlife management, water pollution abatement. Prefer position with opportunity for advancement, more in line with demonstrated ability.

Box J, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S.F., age 35, married, 2 children. Experience: southern pine and hardwoods; 3 years small sawmill operation; 3 years, in management and fire control; 4 years, procurement of forest products, land and timber acquisition with a major wood preserving company. Presently employed. Would like to relocate in Gulf States Area.

Box K, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S., 1950 Iowa State College, age 33, married, 4 children. Experience: with Wisconsin Conservation Department, forest inventory and general district administration; private timber management, Pacific Northwest; nursery and tree farm management, central Wisconsin. Desire permanent position with opportunities for advancement.

Box L, Journal of Forestry, Mills Building, Washington 6, D. C.

Forest economist, equivalent of PhD, nearing end of fifth year of teaching. Married, two children; age 43. Ten years field experience. Skilled at teaching introduction to forestry, elementary mensuration, farm forestry, sawmilling, forest products, timber cruising (summer), and forest economics. Want to continue in teaching or teaching-research, but will consider other offers. Active in church and community affairs.

Box M, Journal of Forestry, Mills Building, Washington 6, D. C.

B.S.F., Univ. of Florida. Age 30, veteran, married, one child. Experience: 1 year on State Forest, 2 years as Service Forester (Farm Forester). Desires change for higher salary and opportunity for advancement. Prefer management position with sawmill in Florida or Southeast.

Box N, Journal of Forestry, Mills Building, Washington 6, D. C.

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